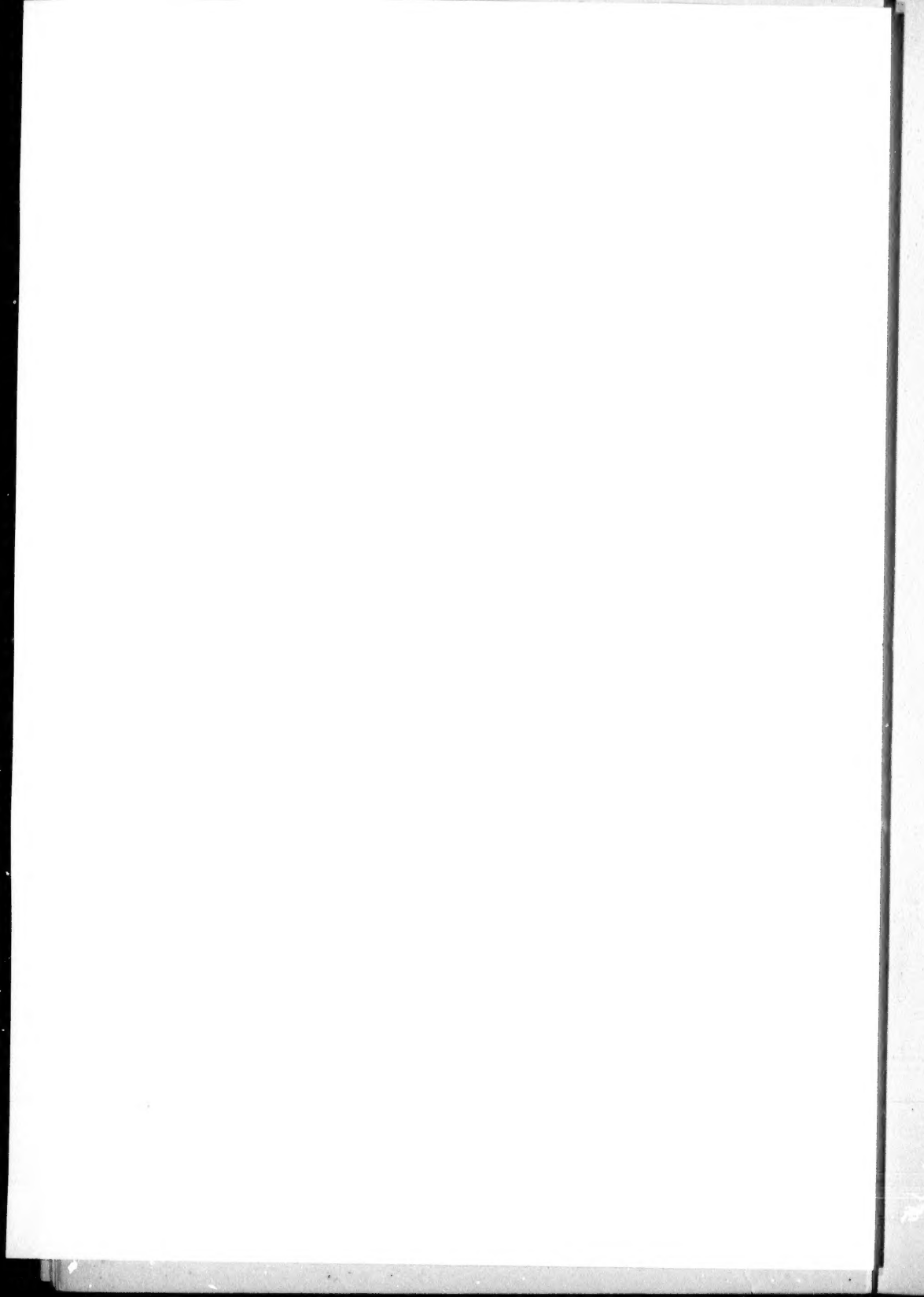




STANDARD TIME.

REPLIES TO QUESTIONS

SUBMITTED BY

SPECIAL COMMITTEE AMERICAN
SOCIETY CIVIL ENGINEERS.

1882.

Ottawa:

PRINTED BY C. W. MITCHELL, 6, 8 AND 10 ELGIN STREET

1882.

AMERICAN SOCIETY OF CIVIL ENGINEERS.

SPECIAL COMMITTEE ON STANDARD TIME.

CHAIRMAN.

SANDFORD FLEMING, Esq., OTTAWA,

Ex-Chief Engineer of the Northern Railway of Canada, the Inter-Colonial Railway, and The Canadian Pacific Railway.

CHARLES PAINE, Esq., NEW YORK,

General Manager New York, West Shore and Buffalo Railroad.

THEODORE N. ELY, Esq., ALTOONA, PA.,

Superintendent of Motive Power, Pennsylvania Railroad.

J. M. TOUCEY, Esq., NEW YORK,

General Superintendent New York Central and Hudson River Railroad.

PROFESSOR J. E. HILGARD, WASHINGTON,

Superintendent United States Coast and Geodetic Survey.

PROFESSOR T. EGLESTON, NEW YORK,

School of Mines, Columbia College.

GENERAL T. G. ELLIS, C. E.,

HARTFORD, CONN.

Cosmopolitan Scheme For Regulating Time.

SUBMITTED BY THE SPECIAL COMMITTEE AMERICAN SOCIETY OF
CIVIL ENGINEERS, WITH QUESTIONS AND OTHER PAPERS.

1. It is proposed to establish one universal standard time common to all peoples throughout the world, for the use of railways, telegraphs and steamboats, for the purposes of trade and commerce, for general scientific observations, and for every ordinary local purpose.

2. It is proposed that standard time, everywhere, shall be based on the one unit measure of time, denoted by the diurnal revolution of the earth, as determined by the mean solar passage, at one particular meridian to be selected as a time zero.

3. The time zero to coincide with the initial or prime meridian to be common to all nations for computing terrestrial longitude.

4. The time zero and prime meridian of the world to be established with the concurrence of civilized nations generally.

5. For reasons elsewhere given it is suggested that the prime meridian and time zero shall be established through the Pacific Ocean, entirely avoiding the land of any nationality, as shown in the plate, (Fig. No. 1.)

6. For the purpose of regulating time everywhere it is proposed that the unit measure, determined as above, shall be divided into twenty-four equal parts, and that these parts shall be defined by standard time meridians, established around the globe, fifteen degrees of longitude of one hour distant from each other.

7. It is proposed that the standard time meridians shall be denoted by the letters of the English alphabet, which omitting *J* and *V*, are twenty-four in number. The zero meridian to be lettered *Z*; the remaining meridians to be lettered in order from east to west, as shown on the plate (See Figs. Nos. 1, 2, 3 and 4.)

8. It is proposed that standard time, determined as above, shall be employed for general and local purposes in accordance with the following definitions :

STANDARD TIME FOR GENERAL PURPOSES.

9. It is proposed that the unit measure of time, determined as above, shall be held to be a *day absolute*, and irrespective of the periods of light and darkness which vary with the longitude, to be common to the whole world for all non-local purposes. To distinguish it from ordinary local days, this space of time may be known as the "Cosmopolitan" or "Cosmic Day." The hours, minutes and seconds of the cosmic day, and the days themselves may be distinguished by the general term *cosmic time*.

10. Cosmic time may be used to promote exactness in chronology; it may be employed in astronomy, navigation, meteorology, and in connection with synchronous observations in all parts of the world. It may be regarded as the time which would be used in ocean telegraphy and in all operations of a general or non-local character.

11. It is proposed to distinguish cosmic from local time by denoting

the hours of the former by letters, and of the latter, as at present, by numerals.

12. It is proposed that cosmic time shall be so lettered that the hours will correspond with the twenty-four standard time meridians. When the sun passes meridians *G* or *N* it will be *G* or *N* time of the cosmic day. When it becomes *Z* time, that is to say, when the (mean) sun passes the zero meridian, at that moment, one cosmic day will end and another begin.

STANDARD TIME FOR LOCAL PURPOSES.

13. It is proposed to constitute the lettered divisions of the cosmic day, standards for regulating local time everywhere. Thus reducing the number of standards to twenty-four and furnishing a ready means of passage from cosmic to local time and from one local to any other local time.

14. It is intended that local time at any place on the surface of the globe shall generally be regulated by the standard meridian nearest or most convenient to such place in longitude.

15. It is proposed that the local day at any place shall commence twelve hours before, and end twelve hours after the (mean) solar passage at the standard meridian which governs the time at that place. Local days, so determined, to be regarded in the same light in all ordinary affairs as local days under the present system.

16. It is proposed that local time at any place or at any section of country shall be known by the letter of the particular standard meridian by which it is governed. If local time at any place or in any section be governed by meridian *S* it may be known as Standard *S* time. If by meridian *T* it may be distinguished as Standard *T* time and understood to be one hour later than Standard *S*, two hours later than Standard *R*, and so on.

THE DISTRIBUTION OF STANDARD TIME

17. It is proposed that standard time shall be determined and disseminated under Governmental authority; that time signal stations be established at important centres for the purpose of disseminating correct time with precision, and that all the railway and local public clocks be controlled electrically from the public time stations, or otherwise kept in perfect agreement.

APPLICATION OF THE SYSTEM IN NORTH AMERICA.

18. The adoption of the system in the United States and Canada, would, exclusive of Newfoundland and Alaska, have the effect of reducing the standards of time to four. These four standards R, S, T and U, precisely one hour apart, would govern the time of the whole country, each would have the simplest possible relation to the other, and all would bear equally simple relations to the other standards of the world.

19. It is not proposed to prescribe the exact limits of the sections of country within which, time would be regulated by each standard. In this matter, general convenience would be the guiding principle. As a rule the division lines would assume a central position between the standard meridians. There would be no difficulty in finding division lines either natural, political or commercial, which would fall about midway between each of the four meridians. Probably in some cases a city or town may lie equidistant from two meridians. In such cases geographical considerations, business relations, and other local circumstances, would decide which standard should be adopted. The time used by the Railways would be determined by precisely similar considerations. The time tables and railway clocks would always clearly indicate the standards which regulated the running of trains over particular sections.

20. It is suggested that standard time would generally prevail in the several states and provinces as follows;

STANDARD TIME, MERIDIAN U .	STANDARD TIME, MERIDIAN T .	STANDARD TIME, MERIDIAN S .	STANDARD TIME, MERIDIAN R .
California. Nevada. Oregon. Washington T. Br. Columbia. Vancouver Island. Idaho. Utah. Arizona.	Mexico. Texas. Kansas. Colorado. Nebraska. Wyoming. Dakota. Montana. Manitoba. Saskatchewan. Keewatin.	Louisiana. Mississippi. Alabama. Arkansas. Tennessee. Missouri. Kentucky. Illinois. Indiana. Iowa. Minnesota. Wisconsin. Michigan.	Florida. Georgia. S. Carolina. N. Carolina. Virginia. Ohio. Maryland. Delaware. Pennsylvania. New Jersey. New York. Rhode Island. Connecticut. Massachusetts. Vermont. New Hampshire. Maine. Ontario. Quebec. New Brunswick. Prince Edw'd I'ld Nova Scotia.

21. Reference to the diagram will show that the four meridians, *U*, *T*, *S* and *R*, at intervals each from the other of one hour, would effectively regulate the time of day throughout the whole extent of the United States, Canada and Mexico. But the number of standards can be increased or reduced without interference with the harmony, and cosmopolitan application of the general scheme. Theories have been advanced, still further to reduce the number of standards. If two standards be deemed expedient—meridians *U* and *R* may be selected; one adapted to the eastern, the second to the western half of the Continent. If on the other hand the opinion prevail, that there should be one uniform time for the whole of the North American Continent, meridian *S* might be selected. Meridian *S* would be 90° to the east of the Prime Meridian proposed for all nations. It would pass through Lake Superior and the Mississippi Valley to the Gulf of Mexico. It would be generally central, and would best suit the great body of the population.

THE DIVISION OF THE DAY INTO HOURS.

22. The present division of the day into halves, and these halves into twelve hours, each series of twelve hours being numbered identically, leads to error and inconvenience. This division necessitates the use of the expressions *ante meridian* and *post meridian*, or forenoon and afternoon, or the contractions A. M. and P. M., to identify the particular half day to which any hour belongs. In railway time tables the expressions ordinarily used to specify the half day are liable to be omitted, misplaced or misunderstood. The consequence is that innumerable mistakes are made and uncertainty frequently arises.

The halving of the day and the use of dual numbers to denote the hours is a very old practice, but it confers no single benefit; and beyond its claim to antiquity, has nothing whatever to recommend it, While it will doubtless be extremely difficult to do away with the custom so firmly established by long usage, it is nevertheless important to ascertain what change would be most advantageous, and what modifications, if any, would be most likely sooner or later to meet with general acceptance. Two alternative plans have been suggested.

Firstly.—To have only one series of hours in the day, extending from midnight to midnight, and numbered from one to twenty-four without interruption.

Secondly.—To number the hours between midnight and noon (one to twelve) precisely as at present, and to denote the hours between noon and midnight by letters of the alphabet.

Both propositions would obviate the necessity of adding words of explanation, or otherwise specifying, whether the hours were forenoon or afternoon. The first would be extremely simple. The second would have the advantage of distinguishing the forenoon from the afternoon hours by the character of the symbols employed to denote them. The hours of the first half of the day would be known by numerals, of the

TABLE OF CONCURRENT TIME THROUGHOUT NORTH AMERICA.
The first Column indicates Cosmic Time; the remaining Columns Local Time. Under each Standard for Local Time is given the Present Division of Hours, Ante Meridian and Post Meridian, side by side with the two Alternative plans suggested.

COSMIC TIME.	LOCAL TIME UNDER EACH SEPARATE MERIDIAN.											
	STANDARD R.				STANDARD S.				STANDARD T.			
	Alternative Plan.		Alternative Plan.		Alternative Plan.		Alternative Plan.		Alternative Plan.		Alternative Plan.	
	Present Division of Hours.	No. 1.	No. 2.	Present Division of Hours.	No. 1.	No. 2.	Present Division of Hours.	No. 1.	No. 2.	Present Division of Hours.	No. 1.	No. 2.
M.....	7	7	7	6	6	6	5	5	5	4	4	4
N.....	8	8	8	7	7	7	6	6	6	5	5	5
O.....	9	9	9	8	8	8	7	7	7	6	6	6
P.....	10	10	10	9	9	9	8	8	8	7	7	7
Q.....	11	11	11	10	10	10	9	9	9	8	8	8
R.....	12	12	12	11	11	11	10	10	10	9	9	9
S.....	1	13	8	12	12	8	11	11	11	10	10	10
T.....	2	14	T	1	13	T	12	12	T	11	11	11
U.....	3	15	U	2	14	U	1	13	U	12	12	U
V.....	4	16	W	3	15	W	2	14	W	1	13	W
X.....	5	17	X	4	16	X	3	15	X	2	14	X
Y.....	6	18	Y	5	17	Y	4	16	Y	3	15	Y
Z.....	7	19	Z	6	18	Z	5	17	Z	4	16	Z

second half by letters. The second plan would have other advantages to recommend it.

The employment of cosmic time letters to denote the hours from noon to midnight, in local reckoning, would make the designation of the afternoon hours everywhere concurrent.

According to the scheme herein submitted there would be, between the Atlantic and Pacific coasts, four standard time meridians, *R*, *S*, *T* and *U*. (See Fig. 4.) The relative time of the day for a few hours before and after noon under these several meridians would be as given in the table appended. An examination will show that under plan number two the noon letter in every instance would agree with the letter by which the standard meridian of the locality would be known. Advancing westerly, local time would become one hour slower from meridian to meridian, as indicated by the numerals which denote the forenoon hours; while the afternoon letters would everywhere be in perfect agreement. The time of New York would be regulated by Standard *R*, Chicago by Standard *S*, Denver by Standard *T*, and San Francisco by Standard *U*, each standard differing by steps of one hour, yet at any given hour in the afternoon, say at *W*, it would be *W* o'clock at the same moment in absolute time from the Atlantic to the Pacific.

QUESTIONS RELATING TO STANDARD TIME.

SUBMITTED BY THE SPECIAL COMMITTEE OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS.

QUESTION 1.—Are you in favor of a comprehensive system of Standard Time for North America?

QUESTION 2.—Do you favor the idea expressed in some of the documents referred to, of bringing the Standards of Time of all countries into agreement?

QUESTION 3.—In order to attain the object set forth in question No. 2, do you consider it advisable to secure a time system for this country which would commend itself to other nations and be adopted by them ultimately?

QUESTION 4.—Referring to the scheme for regulating time (page 28) does it seem to possess any features which generally commend themselves to your judgment?

QUESTION 5.—Do you favor the proposal to have the standards of time differing by intervals of one hour, thus reducing the number of standards for the whole of North America to four, viz.: Meridians Q, R, S and T? (See 18 to 21, pages 30 and 31.)

QUESTION 6.—Do you favor the suggestion to reduce the number of standards in North America to two, say Meridians U and R. (See 21.)

QUESTION 7.—Do you prefer having only one Continental Standard, say Meridian S, and having one uniform time throughout the whole of North America? (See 21 page 31.)

QUESTION 8.—If the scheme set forth in the document referred to (page 28) does not generally meet with your approval, is there any other scheme which you prefer? Please explain your preference for the information of the Committee.

QUESTION 9.—Referring to the suggestions under the heading "Division of the Day into hours" (page 31) please indicate which of the three following plans you prefer.

- (A) The alternative plan No. 1, with the hours numbered from 1 to 24 without interruption?
- (B) The alternative plan No. 2, with the forenoon hours numbered as at present and the afternoon hours lettered as described?
- (C) The present division into half days, known as forenoon and afternoon, each half day having the hours numbered identically from 1 to 12?

QUESTION 10.—In order to secure perfect uniformity and accuracy, do you favor the proposal to have Standard Time disseminated throughout the country by central authority controlled by government. (Page 30.)

QUESTION 11.—Have you any particular views on the question of Time reform, not embraced in the questions and replies above given? If so, please state them for the information and guidance of the Committee. (If necessary on a separate sheet.)

**NAMES OF PARTIES FROM WHOM REPLIES HAVE BEEN RECEIVED
IN ANSWER TO THE CIRCULAR OF QUESTIONS OF THE SPECIAL
COMMITTEE APPOINTED BY THE AMERICAN SOCIETY OF CIVIL
ENGINEERS.**

No.	NAME.	OFFICIAL TITLE.	P.O. ADDRESS.
1.	W.J. McAlpine, M. I. C. E.*	Past Pres. Am. Soc. Civil Eng. . . .	Bay Ridge, L. I., N. Y.
2.	M. Becker*	Chief Engineer P.C. & St. L. R. W. Co.	Pittsburgh, Pa.
3.	Martin W. Harrington.	Director Astr. Observatory.	Ann Arbor, Mich.
4.	H. T. Eddy, Ph. D.	Prof. of Mathematics, Astr. and Cvl. Eng., University of Cincinnati.	Cincinnati, Ohio.
5.	Robert Fletcher, Ph. D.*	Prof. of Civil Engineering	Hanover, Grafton Co., N. H.
6.	P. H. Philbrick*	Prof. C. E., State Univ. of Iowa . .	Iowa City, Iowa.
7.	E. A. Doane*	Chief Engineer, Rome, Watertown & Ogdensburgh R.R.	Oswego, N. Y.
8.	Henry B. Richardson*..	Chief State Engineer	New Orleans, La.
9.	Clemens Herschel*..	R.R. Commissioner, of Massachusetts	Boston, Mass.
10.	H. Stanley Goodwin*..	Asst. Gen. Superintendent, Lehigh Valley R.R. Co.	Bethlehem, Penn.
11.	Robert Briggs*..		1120 Girard st., Philadelphia, Pa.
12.	S. Spencer	3rd V. P. B. & O. R. R.	Baltimore, Md.
13.	C. B. Comstock*..	Lieut.-Colonel of Engineers	Detroit, Mich.
14.	M. S. Greenough*..	Gen. Agt. Boston Gas Light Co. . . .	24 West st, Boston
15.	James R. Maxwell*..	Chief Eng. and Supt. of Const'n., D. O. & O. R. R.	Olney, Ill.
16.	W. A. Doane*..	Principal Asst. Engr., R.W. & O. R.R.	Oswego, N. Y.
17.	Francis J. Lynch, M. I. C. E.	In charge Canadian Pacific Ry. office	Ottawa, Canada.
18.	James H. Rowan, C.E.		Winnipeg, Man.
19.	R. M. Harrod, C.E*..	Memb. Miss. River Commission..	122 Common st., New Orleans.
20.	W. A. May*..	Eng. Hillside C. & I. Co.	Scranton, Pa.
21.	C. S. Master*..	Engineer in charge Western Div. W. L. & G. R. R.	St. Louis, Mo.
22.	James Hall, D. P. S.	Ex-Sheriff and Ex-M. P.	Peterboro', Ont.
23.	Arthur S. C. Wurttele*..	Asst. Eng., N. Y. C. & H. R. R. . .	Albany, N. Y.
24.	W. A. Sweet*..	Pres. Sanderson St. Co.	Syracuse, N. Y.
25.	Wm. T. Jennings	Rest. Engr., C. P. R.	Keewatin, Man.
26.	M. G. Howe*..	Eng. and Supt., H. & T. C. R. R. . .	Houston, Texas.
27.	Robert H. Sayre	Supt. and Eng., Lehigh Valley R.R.	Bethlehem, Pa.
28.	Robert Moore, C. E*..		102 North 4th st., St. Louis, Mo.
29.	J. Foster Crowell*..	Asst. Eng., P. & R.	East Liberty, Pittsburgh, Pa.
30.	John Notman.	Queen's Printer, Province, Ontario.	Toronto, Ont.

* Member American Society Civil Engineers.

No.	NAME.	OFFICIAL TITLE.	P. O. ADDRESS.
31.	T. J. Potter.....	3rd Vice-Pres. and Gen. Man., C. B. & O. R. R.	Chicago, Ill.
32.	W. B. Smellie	Cons. Eng., Canadian Pacific Ry...	Montreal, Ca.
33.	Stephen S. Haight*.....	C. E. and City Surveyor.....	West Farms, N. Y. City.
34.	Julius W. Adams*.....	Past Pres., Am. So. Civil Eng	155 Congress st., Brooklyn, N. Y.
35.	F. N. Gisborne	Supt. Tel. Sig. Serv., Dom. Canada	Ottawa.
36.	James H. Harlow*.....	Eng. Monongahela Navigation Co.	81 Wood st., Pittsburg, Ohio
37.	A. B. Cox*.....		Cherry Valley, N. Y.
38.	Edward S. Philbrick*.....		12 West st., Boston, Mass.
39.	Moncure Robinson*.....		Philadelphia.
40.	Kivas Tully.....	Vice-Pres. Canadian Institute ..	Toronto.
41.	T. H. Perry.....	Chief Eng., L. E. & W. Rd	Lafayette, Ind.
42.	J. W. Putnam*.....	N. O. & M. R. R.	New Orleans.
43.	Charles H. Swan*.....	Member of the Am. Met. Soc., Met. Bnr., A. S. C. E.	25 Wabou st., Highlands, Bos- ton, Mass.
44.	Sir Charles Tupper	Minister of Railways and Canals ..	Ottawa, Ca.
45.	Jos. P. Davis*.....	Vice-Pres. Am. Tel. Co.....	144 Greenwich st., N. Y. City.
46.	P. S. Archibald	Intercolonial Railway.....	Monckton, N. B.
47.	H. E. Stevens*.....	U. S. Asst. Engineer.....	St Paul, Minn.
48.	B. S. Henning	Pres. Ohio Lo. R. W. Co	115 Broadway, N. Y.
49.	J. Milton Titlow*.....	Prin. Asst. Eng., City Hall	Philadelphia, Pa.
50.	Wm. A. Norton.....	Prof. Civil Eng., Sheffield Scient'fic School, Yale College.	New Haven, Conn
51.	C. A. Young	Prof. Astron'y, Col. of New Jersey.	Princeton, N. J.
52.	Robert A. Shailer*.....	Asst. Supt. Edge Moor Iron Works	Wilmington, Del.
53.	L. B. Archibald	Supt. Prince Edward Island Ry ..	Charlottetown, F. E. I.
54.	F. P. Stearns*.....	Asst. Eng., Boston Imp. Sewerage.	Atlanta, Mass.
55.	C. S. Davidson	Supt. Hud. Div. N. Y., N. H. & H. R. R.	Hartford, Conn.
56.	Edward Maguire	Captain of Engineers, U. S. A.....	
57.	E. G. Ferris	Engineer D. & N. R. R.....	South Norwalk, Conn.
58.	Collingwood Schreiber..	Chief Eng. and Gen. Man. Canadian Government Rys.	Ottawa, Ca.
59.	Henry Gannett	Geographer of Census and of U. S. Geological Survey.	Washington, D. C.
60.	James P. Howley	Asst. Geologist	St. Johns, Nfld.
61.	E. P. Alexander.....	Vice-Pres. Louis & Nashville R.... R. Co.	Louisville, Ky.
62.	W. H. Wood	U. S. Asst. Engineer	St. Paul, Minn.
63.	F. M. Towar	U. S. Asst. Engineer	St. Paul, Minn.
64.	Julius J. Duraye	U. S. Asst. Engineer	St. Paul, Minn.
65.	Thomas S. Sedgwick* ..	Land Agt., Atlantic & Pacific Rail- road Co.	Albuquerque, N. M.

* Member American Society Civil Engineers.

No.	NAME.	OFFICIAL TITLE.	P. O. ADDRESS.
66.	Geo. M. Dawson	Asst. Director Geological Survey ..	Ottawa, Ca.
67.	T. C. Mendenhall	Prof. Physics, Ohio State Univ. ...	Columbus, Ohio.
68.	L. J. LeConte*	Res. Eng. Oakland Harbour	Oakland, Alameda Co., Cal.
69.	Edward C. Pickering ...	Director Harvard Coll. Observatory	Cambridge, Mass.
70.	H. F. Royce	Division Superintendent	Des Moines, Iowa
71.	J. S. Sewall*		St. Paul, Minn.
72.	Wm. B. Hazen	Brig. and Brevet Maj.-Gen., Chief Signal Officer, U. S. A.	Washington.
73.	J. M. Buchan	Principal U. C. College	Toronto.
74.	G. Kennedy, M.A., LL.D	Law Clerk, Crown Land Dept.	Toronto.
75.	E. D. Ashe	Director Quebec Observatory	Quebec.
76.	Wm. P. Judson*	U. S. Asst. Eng.	Oswego, N. Y.
77.	Wilson Crosby*	C. E.	Bangor, Me.
78.	W. H. Pratt	Cor.-Sec. and Curator Acad. Nat. Science.	Davenport, Iowa.
79.	George S. Gatchell	Gen. Supt. B. N. Y. P. R. R.	Buffalo, N. Y.
80.	H. S. Pritchett	Prof. Astron. and Director Obser- vatory, Washington University.	St. Louis, Mo.
81.	C. J. Ives	Gen. Supt. B. C. R. & W. Ry.	Cedar Rapids, Ia.
82.	Asa Horr, M.D*	Pres. Iowa Inst., Sc. and Art	Dubuque, Iowa.
83.	J. L. Gillespie	U. S. Asst. Eng.	St. Paul, Minn.
84.	William P. Anderson ..	Eng. to Marine Dept. in charge con- struction Canadian Light Houses.	Ottawa, Canada.
85.	Rufus Ingalls	Quarter-Master General and Brevet Major-General, U. S. A.	Washington.
86.	W. E. Jacobs		Salt Lake City,
87.	Winslow Upton	Army Signal Office	Washington.
88.	H. A. Howe	Prof. of Math. and Astron., Univ. of Denver.	Colorado.
89.	D. R. Taylor	District Supt., N. P. R. R.	Mandan, D. T.
90.	J. R. Eastman	Prof. Math. U. S. N., U. S. N. Obser- vatory.	Washington.
91.	James R. Barber	Railway Superintendent	Cobourg, Ont.
92.	Simon P. Newcomb	Supt. Naut. Almanac, Navy Dept.	Washington.
93.	DeVolson Wood*	Prof. Math. and Mechan., Stevens' Institute, Tech.	Hoboken, N. J.
94.	Wm. F. Ellice	Chief Engineer Connotton Val. Ry. Company.	Canton, O.
95.	Alex. Murray, C. M. G., F. G. G.	Director Geological Survey, New- foundland.	St. Johns, Nfld.
96.	Edwin A. Hill	Attorney, etc. Boston & New York Air Line Ry.	New Haven, Conn.
97.	C. D. Ward*	Windsor Hotel	Jersey City.
98.	M. C. Meigs	Brig.-Gen. U. S. Army (Retired) ...	Washington.
99.	Julius Pohlman	Curator Museum. Buffalo Society Natural Sciences.	Buffalo.
100.	J. C. Wood	Gen. Manager's Assistant, Chicago & Alton Ry.	Chicago, Ill.
101.	Lewis Bass	Director Dudley Observatory	Albany, N. Y.
102.	Melville Dui	Sec. Am. Metro. Bureau	32 Hawley st., Boston.
103.	Chas. A. Schott	Asst. U. S. Coast and Geodetic Surv.	Washington.

* Member American Society Civil Engineers.

No.	NAME.	OFFICIAL TITLE.	P. O. ADDRESS.
104.	David H. Jerome	Governor of Michigan	Lansing, Mich.
105.	W. T. Sampson	Commander U.S.N., Asst. to Supt. Naval Observatory.	Washington.
106.	Ormond Stone	Astronomer Cincinnati Observatory	Mount Look Out, Ohio.
107.	H. S. S. Smith	Prof. Astronomy, K.S.U.	Lawrence, Kansas
108.	Wm. Brydson-Jack	Pres. University, New Brunswick	Frederickton, N.B.
109.	John B. Hamilton	Supervising Surg.-Gen. U.S. Marine Hospital Service.	Washington.
110.	Henry F. McLeod, M.I.C.E.	Resident Engineer, Canadian Pacific Railway.	Drynock, B.C.
111.	Jacob M. Clark*	C. E.	119 Liberty st., New York.
112.	Geo. C. Wilkins	Supt. Balt. Div. Northern Central Ry. and Balt. & Potomac Ry.	Baltimore, Md.
113.	H. P. Dwight	Gen. Manager Great North-Western Telegraph Co.	Toronto.
114.	William F. Bradbury	Hd. Master, Cambridge High School	Cambridge, Mass.
115.	S. L. We dan	Vice Pres. and Gen. Man. Houston Belt Ry.	Houston, Texas.
116.	T. W. Pearl	U.S. Asst. Eng.	Brownville, Neb.
117.	M. Giddings		Bangor, Me.
118.	R. R. Call	U.S. Consular Agent	Newcastle, N.B.
119.	J. W. Mallett	Prof. Chemistry, Univ. of Virginia.	Albermarle Co. Va
120.	Fred. T. Newberry	Asst. Eng., Southern Pacific Ry.	Townsend st., San Francisco, Cal
121.	D. Hudson Shedaker	Civ. Eng.	425 South Broad st Philadelphia.
122.	Edwin Gilpin, jr., A.M., F.G.S., F.R.S.C., &c.	Govt. Inspector of Mines	Halifax, N.S.
123.	John Twigg	Town Clerk	Picton, Ont.
124.	F. P. Dunnington	Prof. Anal. Chemistry, University of Virginia.	
125.	Franc's H. Smith	Prof. Natl. Philosophy, University of Virginia.	
126.	Clarence J. Blake	Fellow American Academy Arts and Sciences, etc.	226 Marlboro' st., Boston.
127.	Wm. M. Thornton	Adj. Prof. Eng., Univ. of Virginia.	
128.	Albert Chapman Savage	City Engineer	El Paso, Texas.
129.	M. C. Fernald	Pres. State College	Orono, Me.
130.	John H. Blake		Boston, Mass.
131.	Ed. Fontaine	Professor, etc., etc	Jackson, Wis.
132.	Fred. Brooks*	Asst. Eng. Ferro Carril Central Mexicano.	San Luis Potosi, Mexico.
133.	N. Bouthillier de Beaumont.	Pres. de la Societ� de Geographie.	Geneva.
134.	Andrew Ingraham	Principal Friends' Academy	New Bedford, Mass.
135.	Joseph Trutch, M.I.C.E.	Dominion Government Agent	Victoria, B. C.
136.	Alex. S. Christie	Coast and Godetic Survey	
137.	E. P. Hannaford	Chief Engineer, Grand Trunk Ry. of Canada.	Montreal.

* Member American Society Civil Engineers.

DRESS.

fich.
n.

ok Out,

Kansas
on, N.B.
n.

B.C.

7 st.,
York.
Md.

Mass.
exas.

Neb.

N.B.
Co. Va
t.,
co, Cal
oad st
nia.
3.

.....

.....

' st.,

.....
as.

.
.
osi,
xico.

Mass.
C.
.....

REPLIES

*IN ANSWER TO CIRCULAR OF QUESTIONS ISSUED BY SPECIAL
COMMITTEE OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS.*

STANDARD TIME.

		QUESTION 1.
No. Am. Society. Civil Engineers	NAME.	Are you in favor of a comprehensive system of Standard Time for North America?
1	W. J. McAlpine, M.I.C.E.....	Yes.
2	M. J. Becker.....	Yes.
3	Mart W. Harrington.....	Yes.
4	H. T. Eddy, Ph.D.....	I am.
5	Robert Fletcher, Ph.D.....	Yes, emphatically.
6	P. H. Philbrick.....	I am.
7	E. A. Doane.....	Yes.
8	Henry B. Richardson.....	Yes.
9	Clemens Herschel.....	Yes.
10	H. Stanley Goodwin.....	Yes.
11	Robert Briggs.....	Certainly.
12	S. Spencer.....	Yes.
13	C. B. Comstock, Lieut. Colonel of Engineers, U.S.A.	Yes.
14	M. S. Greenough.....	Yes.
15	James R. Maxwell.....	Yes.
16	W. A. Doane.....	Yes.
17	Francis J. Lynch, M.I.C.E.....	I am.
18	James H. Rowan.....	I am very strong'y in favor of it.
19	B. M. Harrod.....	Yes.
20	W. A. May.....	Yes.
21	C. S. Master.....	Yes.
22	James Hall, D.P.S.....	I am most anxious to have it estab- lished.
23	Arthur S. C. Wurtele.....	Not as a new system, but I would favor a uniform railroad time.
24	W. H. Sweet.....	Yes.
25	Wm. T. Jennings.....	I am.
26	M. G. Howe.....	Yes.
27	Robert H. Sayre.....	I am, decidedly.
28	Robert Moore.....	Yes.
29	J. Foster Crowell.....	Yes, most decidedly.
30	John Notman.....	I am, and hope to see it effected soon.
31	T. J. Potter.....	Yes.
32	W. B. Smellie.....	I think it greatly to be desired.
33	Stephen S. Haight.....	Yes.
34	Julius W. Adams, Past Pres. Am. Soc. C.E.	Yes.
35	F. N. Gisborne.....	Yes.

QUESTION 2.	QUESTION 3.
<i>Do you favor the idea expressed in some of the documents referred to, of bringing the Standards of Time of all countries into agreement?</i>	<i>In order to attain the object set forth in Question No. 1, do you consider it advisable to secure a time system for this country which would commend itself to other nations and be adopted by them ultimately?</i>
1 Yes	Yes.
2 Yes	Yes.
3 No	No.
4 I think it most desirable	I do.
5 Yes	Yes.
6 I do	I do.
7 Yes	Yes.
8 I do	Yes.
9 Yes	Yes.
10 Yes	Yes.
11 Certainly	Certainly.
12 Yes; but I think it will be best for America to lead and not wait for foreign co-operation.	Yes.
13 American time should have Greenwich for zero meridian.	Yes, if practicable; if not, act independently of them.
14 No	No.
15 Yes	Yes.
16 Yes	Yes.
17 I do	I do.
18 I do	I do.
19 Yes	Yes.
20 Yes	Yes.
21	
22 I do, and think it would confer a great benefit on the civilized world.	I do.
23 The thing is chimerical; all countries will probably take care of their own time.	Who could be the judge whether a so-called system would so commend itself?
24 Yes	Certainly.
25 I do	I do.
26 Yes	Yes.
27 I do	I think it very desirable.
28 Yes	Yes.
29 Yes after the North American system is in successful operation.	Yes.
30 I favor that	Yes, for North America, or rather the American continent.
31 Yes	Yes.
32 I do	Yes.
33 Yes	Yes.
34 Yes	Yes.
35 Yes	I think it will be necessary to take the initiative movement in North America.

No. Ans. C.E.	NAME.	QUESTION 1.
36	James H. Harlow.....	Yes.
37	A. B. Cox.....	I am.
38	Edward S. Philbrick.....	I am.
39	Moncure Robinson.....	I am.
40	Kivas Tully.....	Yes.
41	T. H. Perry.....	Yes.
42	J. W. Putnam.....	Yes.
43	Charles H. Swan.....	Yes.
44	Sir Charles Tupper.....	Yes. I gave evidence of this by establishing a standard time for the Intercolonial Railway, 840 miles in length, which was worked on three distinct times, when I became head of the Department of Railways.
45	Jos. P. Davis.....	Yes.
46	P. S. Archibald.....	Yes.
47	H. E. Stevens.....	Yes.
48	B. S. Henning.....	Yes.
49	J. Milton Titlow.....	Yes.
50	Wm. A. Norton.....	Yes.
51	C. A. Young.....	Yes; by all means.
52	Robert A. Shailer.....	Yes.
53	L. B. Archibald.....	I am.
54	F. P. Stearns.....	Yes.
55	C. S. Davidson.....	Yes.
56	Edw. Maguire.....	Yes.
57	E. G. Ferris.....	Yes.
58	Collingwood Schreiber.....	Yes.
59	Henry Gannett.....	Decidedly.
60	James P. Howley.....	I think it would tend greatly to simplify time reckoning.
61	E. P. Alexander.....	I am, most heartily.

QUESTION 2.	QUESTION 3.
36 Yes	Yes.
37 I do, though it is a matter of less importance to us.	It would be better for us to do the best we can for ourselves, and not sacrifice our plan on the grand idea of revolutionizing the world.
38 I do favor it.....	I do, by all means; such a change should be well considered and not subject to future amendment, to become cosmopolitan.
39 I do.	I do.
40 Yes	Yes.
41 Yes	Yes.
42 ———	I think a continuous numbering of hours and sub-divisions upon the decimal plan advisable, and a new arrangement of the days into months, giving 31 days to the first five months, and six months in leap year, and 30 days to each of the remaining months, would be beneficial.
43 Yes	Yes.
44 Yes	Yes.
45 Yes	Yes.
46 Yes	Yes.
47 Yes	Yes.
48 Yes	Yes.
49 Yes	Yes.
50 Yes	Yes.
51 Yes	Yes; meridian 12h from Greenwich.
52 Yes	Yes.
53 I do.	I do.
54 Yes	Yes.
55 Yes	Yes, provided it can be so arranged.
56 Yes	Yes.
57 Yes	Yes.
58 Yes	Yes.
59 Eventually this can be and should be done.	If, as is probable, we are to be the first to adopt such a system, we should make provision for its universal application.
60 It would be very desirable, but probably very difficult to effect.	The adoption of such a system in America would, I have no doubt, recommend itself to all English speaking peoples at least.
61 I do, but favor <i>early action in the U.S.</i> , without waiting on other countries.	It will, of course, be very desirable that the system adopted for the U.S. should be capable of extension to the whole globe.

by
the
in
dis-
the

to

No. Am Sec C.E.	NAME.	QUESTION 1.
62	W. H. Wood.....	Yes.
63	F. M. Towar.....	Yes.
64	Julius J. Duraye.....	Yes.
65	Thomas S. Sedgwick.....	I am,
66	Geo. M. Dawson.....	Yes.
67	T. C. Mendenhall.....	Yes.
68	L. J. LeConte.....	Yes.
69	Edward C. Pickering.....	Yes.
70	H. F. Royce.....	Yes.
71	J. S. Sewell.....	Yes.
72	Wm. B Hazen, Major-Gen. U.S.A.	Yes.
73	J. M. Buchan.....	Yes.
74	George Kennedy.....	Yes.
75	E. D. Ashe.....	Yes.
76	Wm. P. Judson.....	Yes, decidedly.
77	Wilson Crosby.....	Yes.
78	W. H. Pratt.....	Undoubtedly.
79	Geo S. Gatchell.....	Yes.
80	H. S. Pritchett.....	Yes.
81	C. J. Ives.....	Yes.
82	Asa Horr.....	Yes.
83	J. L. Gillespie.....	Yes.
84	Wm. P. Anderson.....	Yes.
85	Rufus Ingalls.....	Yes.
86	W. E. Jacobs.....	Yes; I quite concur with the various arguments in its favor given in your pamphlet, especially in regard to railroad time.
87	Winslow Upton.....	Yes.
88	H. A. Howe.....	I am.
89	D. R. Taylor.....	Yes.
90	J. R. Eastman.....	I am for the United States.
91	James R. Barber.....	Yes.
92	Simon P. Newcomb.....	Yes.
93	DeVolson Wood.....	Yes.
94	Wm. F. Ellice.....	Yes, it is very desirable.

QUESTION 2.	QUESTION 3.
62 Yes	Yes.
63 Yes	Yes.
64 Yes	Yes.
65 " by equations of equality.....	Yes, if they should be pleased to so do!
66 "	Yes.
67 Yes	Yes, decidedly, for many reasons—this is the place to begin.
68 Yes	Yes.
69 Yes	Yes.
70 Yes	Yes.
71 Yes	Yes.
72 Yes	Yes.
73 Yes	Yes.
74 Yes	Yes.
75 Yes	Yes.
76 The idea is a good one, but do not consider it now practicable nor especially important to us.	Yes.
77 Yes	Yes.
78 Certainly. Whatever be adopted it should be with that view.	Highly desirable; the sooner a well digested system can be inaugurated the better.
79 Yes, sir.....	I do.
80 Yes	Yes.
81 Yes	Yes.
82 Yes	Yes.
83 Yes	Yes.
84 Yes	Certainly.
85 Yes, so far as practicable.....	Most certainly.
86 I think it would be an advantage, though not to so great a degree as in each great division of the world separately.	Yes; with our great expanse of country the question assumes greater importance than to any other nation.
87 Yes	Yes.
88 I do.....	I favor a meridian passing through Greenwich, and think that if it is 180° from Greenwich the world would be more likely to accept it than if it is in any other place.
89 Yes	Yes.
90 No	No.
91 Yes	Yes; I think the representatives of other countries should be consulted even though these nations did not at present adopt the improved system.
92 No; it is simply burdening the reform with a useless condition.	No; we don't care for other nations, can't help them, and they can't help us.
93 Yes	I would aim to do so.
94 Certainly	Unless we secure such a system we fail to secure the objects aimed at in No. 2.

No. Am. Soc. C.E.	NAME.	QUESTION 1.
95	Alex. Murray	Most certainly.
96	Edwin A. Hill	Most decidedly.
97	C. D. Ward	Yes.
98	M. C. Meigs, Brig.-Gen. U. S. A. . .	Yes.
99	Julius Pohlman	Yes.
100	J. C. Wood	Yes, for transportation and commercial purposes.
101	Lewis Bass	Theoretically yes, with the restrictions as to local time hereinafter mentioned.
102	Melville Dui	Very strongly.
103	Chas. A. Scott	Yes, for the Railroad and Telegraph service but not for ordinary local business life.
104	David H. Jerome	Certainly.
105	W. T. Sampson	Yes, for all purposes of communication between different points.
106	Ormond Stone	Yes.
107	H. S. S. Smith	Yes.
108	W. Bryndone Jack	Yes.
109	John B. Hamilton	Yes.
110	Henry F. MacLeod, M.I.C.E.	Yes, I think it would be a great advantage.
111	Jacob M. Clark	Negative.
112	Geo. C. Wilkins	Yes.
113	H. P. Dwight	Yes.
114	William F. Bradbury	Yes.
115	S. L. Werden	Emphatically I am.
116	T. W. Pearl	Yes.
117	M. Giddings	Yes.
118	R. R. Call	For the travelling public it would undoubtedly be a convenience; for local purposes its utility would be questionable.

QUESTION 2.	QUESTION 3.
95 Consider such would be of very great advantage to the whole world if once effected.	I highly approve of the plan proposed and believe its success in America would insure its success in Europe.
96 Yes if it can be done.....	Yes, provided that in so doing the system adopted would be suited to our requirements and not compromised too much for the sake of International uniformity.
97 Yes	Yes, decidedly.
98 Yes	Yes.
99 Yes, if possible.....	I would be in favor of standard time whether acceptable to other nations or not.
100 Yes, commercial time.....	Yes.
101 In the sense of reply No. 1, that would be desirable I think.	Yes.
102 Yes	Yes.
103 Yes, for all international communications.	Yes, for the internal administration of all Railroads and Telegraphic service only.
104 Yes	Yes, but the system should be primarily for the convenience of Americans.
105 Think it desirable that the standard used on each continent for purposes of communication should be accepted after the same method.	Yes.
106 ———	Yes.
107 Yes	Yes.
108 Yes	No ; the change must be adopted by general treaty or it will never come into use. It is less likely to become general if any single nation originates the movement.
109 Yes	Yes. The satisfactory working of the system in such a vast country as North America would no doubt tend to its universal adoption.
110 Yes, and hope it will soon be accomplished.	Only to the extent of establishing a prime standard of reference.
111 Negative, except for the civic date.	Yes, by all means.
112 Yes	Yes.
113 Yes	Yes.
114 Yes	I do.
115 Yes, I do.....	Yes.
116 Yes	Very desirable.
117 Yes	The adoption and successful use of such a system in America would probably lead to its establishment in Europe also.
118 Yes	

No. Am. Soc. C.E.	NAME.	QUESTION 1.
119	J. W. Mallett.....	Yes.
120	Fred. T. Newberry.....	Yes.
121	D. Harrison Shedaker.....	Yes.
122	Edwin Gilpin.....	Yes.
123	John Twigg.....	Yes.
124	F. P. Dunnington.....	Yes.
125	Francis H. Smith.....	I am.
126	Clarence J. Blake.....	Yes.
127	Wm. M. Thornton.....	Yes.
128	Albert Chapman Savage.....	Yes.
129	M. C. Fernald.....	I favor such a system.
130	John H. Blake.....	Yes.
131	E. Fontaine.....	Yes, but the cosmic meridian or zero for the calculations of latitude and longi- tude and time should be at Greenwich, England.
132	Fred. Brooks.....	Yes.
133	N. Bouthillier de Beaumont.....	Not entirely.
134	Andrew Ingraham.....	_____
135	Joseph Trutch, M.I.C.E.....	_____
136	Alex. S. Christie.....	_____
137	E. P. Hannaford.....	_____

QUESTION 2.	QUESTION 3.
119 Yes	Yes.
120 No. Prefer to begin with North America.	First two lines, yes; latter part of no particular interest.
121 Yes	Yes.
122 Ultimately	Yes.
123 Yes	Yes.
124 Yes	Yes.
125 I do.	I do.
126 Yes	Yes.
127 Yes	Yes.
128 Yes	Yes.
129 I do.	I do.
130 Yes	Yes.
131 Yes, nothing is more necessary to satisfy the practically scientific wants of the 19th century.	The time system for this country and all others can be best regulated at Greenwich, England.
132 Yes	Yes; I think the time system secured ought to be a system for all countries having nothing distinctly American about it, so that other nations could adopt it either before or after the North American countries, as a cosmopolitan system and not subordinate themselves thereby to North America. I do not consider it favorable to obtain a good result.
133 No	
134 ———	—————
135 ———	—————
136 ———	—————
137 ———	—————

zero
angi-
vich,

	QUESTION 4.
Nos. Am. Society, Civil Engineers NAME.	<i>Referring to the scheme for regulating time (page 28), does it seem to possess any features which generally commend themselves to your judgment?</i>
1 Wm. J. McAlpine, M.I.C.E.	Yes.
2 M. J. Becker.....	The scheme set forth on pages 28 to 30 seems to cover the entire ground within the limits of reasonable practicability and hope of ultimate accomplishment.
3 Martin W. Harrington	
4 H. T. Eddy, Ph.D.....	The suggestions in the main commend themselves to my judgment.
5 Robert Fletcher, Ph. D.....	In my judgment the scheme is well adapted to the object in view.
6 P. H. Philbrick.....	It does.
7 E. A. Doane.....	Yes.
8 Henry B. Richardson.....	Any unification of time standards seems to me an improvement on the present system, or no system, of marking local time, but I see no objection to the general and local use of what is called "cosmic time" (p. 29). Why it should be of any importance to me whether the sun is on my meridian at 12 o'clock or at 19 o'clock I am at a loss to understand so that I and my neighbors know <i>when</i> it is and have the same name for it.
9 Clemens Herschel.....	Yes.
10 H. Stanley Goodwin.....	Yes.
11 Robert Briggs.....	
12 S. Spencer.....	Except 5, where I hold the meridian should be Greenwich, and the zero exactly 180° therefrom.
13 C. B. Comstock.....	Yes: I think the scheme on the whole a good and sufficient one.
14 M. S. Greenough.....	
15 Jas. R. Maxwell.....	I to 7, 13 to 16 and 17, 18 to 20 seem judicious.
16 W. A. Doane.....	I question the advisability of attempting too much at first. We shall, I fear, accomplish nothing if we seek for too radical a change.
17 Francis J. Lynch, M.I.C.E.....	Yes.
	Yes.
	It does. A prime meridian, for the use of all nations for scientific purposes, I consider to be a fast growing necessity, and its proposed establishment mid

QUESTION 5.	QUESTION 6.
<i>Do you favor the proposal to have the standards of time differing by intervals of one hour, thus reducing the number of standards for the whole of North America to four, viz.: Meridians, Q, R, S and T? (See 18 to 21, pages 30 and 31.)</i>	<i>Do you favor the suggestion to reduce the number of standards in North America to two, say Meridians U and R?</i>
1 Yes	No.
2 Yes	No.
3 Yes	_____
4 I think this the more practicable system.	I prefer the single meridian for the continent.
5 Yes; this is more in accordance with the scheme in its general relations.	No.
6 I do, but I would prefer but 10 hours and 10 meridians, etc.	Yes; if there were 10 in all there would be only 2 in North America.
7 Yes	No.
8 _____	_____
9 Yes	No.
10 Yes	No.
11 Certainly	No.
12 Yes; I am inclined to think this the plan promising most satisfactory results, and most likely to meet with public favor.	I prefer 4 standards.
13 Yes	No.
14 Yes	No.
15 I do.....	_____
16 Yes	No.
17 No	No.

No. Am Soc C.E.	NAME.	QUESTION &.
		Pacific well chosen, by reason of its relative position to Greenwich. The division into standard time meridians, one hour apart, and designated by letters, will afford a convenient method of comparing local times, though in matter of local time I advocate the smallest number of standards found practicable.
18	James H. Rowan, C.E.....	It does generally. With reference, however, to the "time zero" and "prime meridian" for the whole world, I have to say that, while there is much to commend the zero referred to as being placed in the Pacific Ocean for national and political reasons, there are higher, better and cosmical reasons (too extensive to enter into a detail of here) why the longitude of the Great Pyramid in Egypt should be adopted as the prime meridian.
19	B. M. Harrod, C.E.....	I approve generally of the scheme set forth by Mr. Fleming.
20	W. A. May.....	Its simplicity and its basis, as well as its adaptability and practical character.
21	C. S. Master	Make time uniform for this coun'ry.
22	James Hall, D.P.S.....	It does.
23	Arthur S. C. Wurtele.....	I think the scheme complicated and absurd, and think all this fancied uniformity is a kind of philosophers' stone. The prime meridian has been observed (<i>sic</i>) over and over again, but the matter of convenience has prevented any change. The use of letter meridians would only complicate a simple matter.
24	W. A. Sweet.....	Yes; the scheme seems to fully fill all requirements.
25	Wm. T. Jennings.....	The who's scheme appears to me practical, and would, if carried out, result satisfactorily.
26	M. G. Howe.....	I think that it will be only a partial remedy for inconveniences now experienced. There will be the same confusion at localities near the "standard time meridians" that we now have everywhere, and a railroad crossing such meridian could not change its time at such crossing unless it happened to be at a terminal point.
27	Robt. H. Sayre	It is the best scheme that has come under my notice.
28	Robt. Moore, C.E.....	I think the scheme an admirable one, and can suggest no better.

QUESTION 5.

QUESTION 6.

18 I do, because more in harmony with the general scheme when made universal.

I should, but that I think it would militate eventually against the universality of the whole scheme.

19 Yes

No.

20 Four standards for the U. S.

No.

21 _____

22 Yes, I do

Yes.

23 This would be inconvenient, and only make more confusion.

I can see nothing advantageous in such a division of time.

24 I do favor this, and it shows much study.

No.

25 I do.

I do not.

26 No, for reasons above given.

No.

27 I do

I do not.

28 Yes

No.

No. Am. Soc. C. E.	NAME.	QUESTION 4.
29	J. Foster Crowell.....	In the main this scheme seems to me admirable, and for the use of educated and especially scientific persons almost perfect; but to render the universal adoption of a radical change possible it must be popular, and the use of let'ers to designate the meridians would complicate the subject to many minds, and create a prejudice. Geographical names or simple numerals, it strikes me, would be better adapted for ordinary use.
30	John Notman.....	I would support the whole cosmopolitan scheme.
31	T. J. Potter.....	Would approve of the division of the globe into 24 time meridians, having zero in the Pacific Ocean, and the employment of standard time for general and local purposes.
32	W. B. Smellie.....	The scheme generally commends itself to my judgment.
33	Stephen S. Haight.....	Yes.
34	Julius W. Adams..... Past Pres. Am So. C. E.	In general and in detail, I can conceive of no method which promises to effect the end in view, through all its complications with so little derangement to the methods of "time-keeping" in use as the one advocated in the paper read by Sandford Fleming.
35	F. N. Gisborne	Yes: as very clearly explained in Mr. Sandford Fleming's address to the American Society of Civil Engineers.
36	James H. Harlow	The scheme is a good one for certain purposes, <i>i. e.</i> , railroads, telegraphs, &c., and provided it could be made perfectly reliable, it would be useful for exact observation to places connected by telegraph, and also to the standard observatory. It would be useful to determine local time by and regulate it. But would be useless unless the means of distribution were general.
37	A. B. Cox	It certainly does; it is based upon good sense. There would, doubtless be local inconveniences, arising along the border lines where we pass from one meridian to another. But these would be incomparably less important than the detestable muddle into which we have thus far drifted by the course of events.
38	Edward S. Philbrick	

QUESTION 5.	QUESTION 6.
-------------	-------------

29 Yes

No; that could easily be done in the future if desirable, but "the time is not yet."

30 I cannot think of anything better for local purposes.

I think so, but would prefer the hour intervals.

31 The question arises whether, in thickly settled nations like the United States, half hour stations would not be better? Thus we would have New York, Cleveland, Chicago, Omaha, Denver, Ogden and San Francisco time, varying by half hours, but agreeing on the general meridians.

Should not consider the reduction of meridians to two or one advisable.

32 I favor the proposal to have four standards for the whole of North America.

33 Yes

No.

34 Yes

No.

35 Yes

No.

36 Yes: R. S. T. & U.

37 A difference of an hour is too large if anything

38 I do

I don't see the advantage of this.

No. Am. Sec. C.E.	NAME.	QUESTION 4.
39	Moncure Robinson	It seems to me to have many.
40	Kivas Tully.....	Scheme approved.
41	T. H. Perry	Yes; from p. 1 to 5, but not agreeable to 6 and 7.
42	J. W. Putnam.....	
43	Charles H. Swan	Yes; answered more fully in reply 11.
44	Sir Charles Tupper	Yes.
45	Jos. P. Davis	The scheme is a good one.
46	J. S. Archibald.....	Yes; I can suggest nothing better.
47	H. E. Stevens	Yes.
48	B. S. Henning.....	Yes.
49	J. Milton Titlow.....	Yes.
50	Wm. A. Norton.....	I approve paragraphs 1, 2, 3, 4 and 7. I should prefer the meridian of Greenwich for the prime meridian certainly one running through some observatory that all nations might agree upon. I do not favor the attempt to divide the day into twenty-four hours for civil purposes.
51	C. A. Young.....	I like it in nearly every respect, but would prefer geographical designations for the time standards, <i>e.g.</i> Atlantic, Mississippi, Mountain and Pacific times, but am not strenuous.
52	Robert A. Shailer	Yes.
53	L. B. Archibald.....	I think the scheme a good one. Some difficulties might arise at first in carrying it out, but eventually it would be found a great improvement on our present system.
54	F. P. Stearns.	Yes; nearly all of the features seem good. I think reducing the number of meridians in North America to two, would cause too large a variation from true local time. I do not think standards varying one hour would cause confusion; particularly if railroad and other clocks were marked on the same dial with the figures of local and the letters of standard "cosmic" time, thus familiarizing people with the relations between the two.
55	C. S. Davidson.....	Sec. 1, 6, 9, 13, 14, 15, 17.
56	Edw. Maguire.....	The scheme appears to me to cover all points, and is satisfactory.
57	E. G. Ferris.....	Yes.
58	Collingwood Schreiber	Yes.
59	Henry Gannett.....	

QUESTION 5.	QUESTION 6.
39 I do not	I do not.
40 Yes; for local time	No.
41 No	No.
42 I think not	I do not.
43 Yes; for municipal time only.....	No; more fully answered in replies 7 and 11.
44 No	No.
45 Yes	No.
46 Yes	No.
47 Yes	No.
48 No	No.
49	_____
50 I do.....	_____
51 Yes; but I do not like the designation by <i>letters</i> .	No.
52 Yes	No; I think four meridians preferable.
53 See answer to Q. 7	See answer to Q. 7.
54 Yes	No.
55 Yes	No.
56 Yes ..	No.
57 Yes, but only one standard should be used in any one State.	No.
58 No	No.
59 I think this preferable to the other plans proposed.	_____

No. Am. Soc. C.E.	NAME.	QUESTION 4.
60	James P. Howley.....	The scheme appears to be a capita. one, and if once universally agreed to would, I have no doubt, give general satisfaction. I would anticipate, however, much opposition to it, owing to national prejudices and from a strong objection to alter in any way the existing mode of reckoning time common to each country.
61	E. P. Alexander.....	It seems as simple and perfect as possible.
62	W. H. Wood.....	Yes; except that I think it better to number the standard meridians 1st, 2nd, &c., instead of lettering them.
63	F. M. Towar.....	No improvement in the suggestions on page 28 presents itself to me. The whole scheme seems to have been thoroughly thought out before being presented.
64	Julius J. Daray.....	Yes; prefer to use numerals in place of letters to designate meridians.
65	Thomas S. Sedgwick.....	I agree generally with the scheme of page 4.
66	Geo. M. Dawson.....	The adoption of the cosmic day would render it desirable that all ephemerides for astronomical or nautical purposes should be calculated for the initial meridian instead of to different meridians, as at present and result in a great saving of labour.
67	T. C. Mendenhall.....	I like it on the whole better than any other with which I am acquainted.
68	L. J. LeConte.....	The proposed scheme is commendable in every respect. In regard to division of day into hours, however, I fail to see public necessity of a radical change. The first suggestion of 1 to 24 is the most natural one to adopt for professional purposes.
69	Edward C. Pickering.....	Yes.
70	H. F. Royce.....	Yes; it seems practicable and desirable in general.
71	J. S. Sewell.....	I see no better way.
72	Wm. B. Hazen, Brig. Gen. U.S.A.	Yes. In the main the system commends itself, but there is no objection to the omission of some of the meridians, and the adoption of some one over a large area of country that is well populated. Thus the use of the S. meridian for the whole of the U. S. is advised as below.
73	J. M. Buchan.....	Yes.
74	George Kennedy.....	I approve generally of the scheme.
75	E. D. Ashe.....	Yes; excepting clauses 7 and 12, and those depending on them.

QUESTION 5.	QUESTION 6.
60 I should much prefer intervals of 15°, or one hour between the standards.	Hourly standards would, I imagine, be far preferable.
61 Yes	Not so much as four. We risk arousing ignorant prejudices by getting R. R. time very far out from solar time.
62 Yes	No.
63 Yes	No.
64 No	No.
65 No	No.
66 ———	———
67 Yes	No.
68 Yes ; by all means	No.
69 Yes	No.
70 Yes	No.
71 Yes	No.
72 No	No.
73 Yes	No.
74 Yes	No.
75 No	No.

No. Am. Soc C. E.	NAME.	QUESTION 4.
76	Wm. P. Judson.....	Can see nothing to suggest in addition to the scheme set forth.
77	Wilson Crosby.....	Yes.
78	W. H. Pratt.....	1. An absolute essential and must ultimately be done, even if not at first. 2. The only suitable unit of measure. 3. Certainly. 4. Concurrence of all desirable and sure to be accorded sooner or later. 5. Best, as being simpler and avoiding jealousies, &c. 6. The best division as being in universal use, it would be difficult or impracticable to change it. 9, 10, 11, 12, seem to be well arranged. It would doubtless be desirable to adopt such plans in details as would, while carrying out the principle fully, entail the least inconvenience in the way of changes of modes of expression, and of computations for practical purposes of every-day life, with the mass of the people. For scientific purposes there will be no difficulty.
79	George S. Gatchell.....	It does.
80	H. S. Pritchett.....	Yes.
81	C. J. Ives.....	Yes.
82	Asa Horr	Yes ; most decidedly. Last evening I met with a club of very intelligent business men to whom I explained the scheme, and after fully discussing its merits and demerits they unanimously gave it their unqualified approval, preferring one standard S for commercial purposes for the North American Continent, and the numbering of the hours from 1 to 24.
83	J. L. Gillespie.....	I approve the scheme in general, but think details should be left to the Commission asked for in the memorial of the society.
84	Wm. P. Anderson.....	Yes ; the scheme as a whole must commend itself to every man whose business is in any way connected with regions lying at some distance apart. The fixing of a prime meridian, common to all nations, would be of immense commercial convenience, and that chosen would suit the numerous English colonies that now use the Greenwich meridian. Dr. Barnard's idea of naming the meridians by the regions they traverse, is one that would, I think, be more popular, than distinguishing them by letters of the alphabet.

QUESTION 5.	QUESTION 6.
76 Yes	No.
77 Yes. Standards differing by one hour, but this would require 5, viz. : Meridians Q., R., S., T., U., and perhaps W.	No ; not at present ; try the other 5 first.
78 Do not see any difficulties in the way.	Think the division into four for this country would be better.
79 I do	No.
80 Yes	No.
81 ———	———
82 No	No.
83 Have the four standards by all means.	No.
84 I would not like to see standards farther apart than one hour. For the Dominion of Canada I should like to see both Q. and U. meridians used.	No ; There would be great practical inconvenience from having the time at some points differ as much as it would under this system for local astronomical time.

No. Am. Soc. C.E.	NAME.	QUESTION 4.
85	Rufus Ingalls.....	The scheme is a move in the right
86	W. E. Jacobs.....	direction for convenient standard time,
		I approve of the plan generally.
87	Winslow Upton	This system seems the best that can be devised as a general system. It would however, be in practice difficult to establish the division lines between adjacent sections using times differing by one hour. These lines can best be drawn over large borders of water. Over large areas of land it would be well to use one meridian which should be the central one belonging to the cosmopolitan system in that country.
88	H. A. Howe.....	All the features of the scheme suit me, but if civilized nations do not concur, I think that England and America—if they can agree—ought to go ahead; at any rate the United States <i>must</i> have a standard time.
89	D. R. Taylor.....	Yes.
90	J. R. Eastman.....	No.
91	James R. Barber.	Yes. I think it very good, especially sections 1—12 inclusive.
92	Simon P. Newcomb.....	A capital plan for use during the millennium. Too perfect for the present state of humanity. See no more reason for considering Europe in the matter than for considering the inhabitants of the planet Mars.
93	DeVolson Wood	As soon as absolute time is once given to a community, the difference between it and local time will be noted, and thus the regulation of local time will take care of itself more easily than if absolute time be divided into 24 standard times.
94	Wm. F. Ellce.....	I like the general features of the plan. It seems to me that it would be more likely to secure adoption by selecting Greenwich for the prime meridian. It is now so used by a large portion of the civilized world. We would lose $\frac{1}{2}$ to $\frac{1}{4}$ a day which could easily be adjusted. In arranging a universal system of time care should be taken not to make it so scientific that the "plain people" cannot understand it.

QUESTION 5.	QUESTION 6.
85 Yes	The four standard meridians seem the best systems.
86 I think th's method preferable to either of the two following, as the standard time would differ from the sun's time by so much less, not exceeding half an hour.	No ; see above.
87 This seems less desirable than the plans following.	Yes ; unless the next plan is adopted. The Mississippi River makes a good dividing line.
88 I do.....	I do not.
89 Yes	No.
90 No.	No.
91 Yes. Conditionally. See No. 8..	No.
92 This seems to me the best scheme.	_____
93 I do not.....	This may be better than Q. 5.
94 I do.....	No.

No. Am Sec. C.E.	NAME.	QUESTION 4.
95	Alex. Murray.....	The scheme in general seems to me to be highly commendable, but there may be difficulties in the way, in the first instance of getting the concurrence of all nations. The plan of placing the prime meridian, and time zero in the Pacific Ocean I think very desirable, thus obviating all national claims of precedence. The system proposed for regulating time all round the globe by establishing meridians one hour apart from each other, and the plan for indicating the meridians by 24 letters is admirable.
96	Edwin A. Hill	It does. [Some remarks are appended with regard to the naval observatory at Washington; likewise as to train despatching.] ED.
97	C. D. Ward	Think well of having prime meridian established through the Pacific Ocean.
98	M. C. Meigs..... Brig.-Genl. U. S. A.	Yes; generally. It is difficult to change the habits of fifty millions of people. Therefore, I think it better to adhere to the practice of dividing the daylight into, before and after the period at which the mid-day rest of all working people, except scholars, literary, railroad, and other persons begin. A.M. and P.M. should be preserved.
99	Julius Pehlman.....	If we are to have standard time, and local time every where, we may as well keep the present system; but if we do away with local time altogether, we simplify everything. What difference does it make to a man whether his 12 o'clock standard time is really 12h 45m. local time? None whatever. But while the adoption of standard time greatly facilitates travel and commerce, it does not make the slightest difference to the average man whether he counts his day by standard or local time. We should therefore have <i>one standard</i> and no local time for each meridian.
100	J. C. Wood	It does as to a standard time for railway and commercial purposes. But for local purposes, so radical a change would encounter much opposition. A difference in time of one hour at a given meridian would occasion more inconvenience to the public, and be more dangerous on railway lines operating across that meridian than the present double standards of time.

QUESTION 5.

QUESTION 6.

95 It might be of advantage to increase the number of standards by letters P and W, so as to include Newfoundland and Alaska. The meridian of 45° W. strikes the S.W. extremity of Greenland.

No. I should much prefer to have the standard at hourly divisions.

96 In general yes. Subject to still further sub-division into 10 minute standard, if a compromise were deemed desirable.

No; as in this case I should consider it too great a departure from true local time.

97 No.....

No.

98 Yes.....

No.

99 Yes.....

No; the difference between the standard and local time would be too great.

100 I do not consider this practicable..

Two standards would seem to be less objectionable than four.

No. Am Soc. C.E.	NAME.	QUESTION 4.
101	Lewis Bass	For accomplishing the objects there assumed to be desirable, the scheme appears to be a good one.
102	Melville Dui.....	Yes; all qualified as shown here—after for alternatives. It seems to me based on so thorough a study of the subject as to leave little possibility of change for the better in all its essential features.
103	Chas. A. Scott.....	Yes; the proposed use of the Greenwich meridian, and the counting of the hours of the day continuously to 24. The introduction of this count of the hours in R.R. time tables is greatly to be desired. The continuance of counting terrestrial or geographical longitudes from Greenwich is highly desirable, and this use should be recommended to navigators and geographers of other than English-speaking nations.
104	David H. Jerome.....	Yes, it has many very good features. However, the term "Cosmic time" seems to me to be an extraordinary and novel use of the word "Cosmic," which has reference to the <i>Universe</i> and not to the <i>Earth</i> , while the system of time designated "cosmic" in your documents is entirely terrestrial. Also, I think that the prime meridian should be lettered "A." The prime meridian might as well be lettered "P," the initial of "prime," as "Z," the initial of "Zero."
105	W. T. Sampson	Consider the objects to be secured by first five paragraphs desirable, but prefer to use local time for local purposes.
106	Ormond Stone.....	
107	H. S. S. Smith.....	Three especially: 1. Greenwich standard. 2. Local times differing by even hours. 3. Cosmic time for astronomical and similar purposes.
108	W. Brydone-Jack	It does. But it seems to me that the use of 24 letters to designate the standard hour meridians is objectionable, as being clumsy, as suggesting little, immediate or visible connection with the prime meridian, and because the frequent change of letter might lead to hesitancy and confusion. Without having had much time to consider the matter, I venture to suggest the use of only four standard time meridians—the first designated A at 180° west of Greenwich—as the prime meridian; the second B 90° west A; the third C, passing through

QUESTION 5.	QUESTION 6.
101 —————	
102 For local times use each 15° meridian till all can be taught to use cosmic time.	Strongly no. Either 1 or 4. This combines disadvantages of both the others. See Ans. 8.
103 I am not in favor of the scheme..	I do not.
104 Yes, at least to begin with.....	No.
105 I do not favor this proposition....	I do not favor this suggestion.
106 Yes	
107 Yes	No.
108 See answer to question 4.....	See answer to 4. I prefer that easterly from Greenwich C, the hour meridian be designated C ¹ , C ² , C ³ , C ⁴ , C ⁵ .

No. Am Soc. C.E.	NAME.	QUESTION 4.
		Greenwich; the fourth D 90° west of Greenwich, and which would correspond to S in scheme proposed. For general purposes the times to west of each of these standards up to the next would be the local time of the standard. For the convenience of approximating to the local time of places intermediate between the standards, I would use the following notation A⁰, A¹, A², A³, A⁴, A⁵, for hour meridians from A⁰ to B⁰. Thus if an office on D³, where the clock was keeping the standard time of D⁰, the hour indicated by the clock was 5h. 15m., the local time at that office would be 2h. 15m., and the absolute time of day would be 23h. 15m. The local time half way to D¹ on one side and to D² on the other would be approximately to local time of D³, subject to a maximum error of 30 minutes. The local time of a meridian 3 hours east of D⁰, and which would be marked C³, might be found by adding 3 to the D⁰ time or subtracting 2 from the C time. In America it would perhaps be most convenient to keep standard D⁰ time, and add, although for Atlantic shipping the other might be preferable, as being in accordance with long practice. Paragraph 5, page 28, seems especially well adapted for the basis; the avoidance of national jealousy—a not unimportant factor—is assured. The experience of this service in inaugurating the use of the metric system for medical purposes is one that shows us on a small scale how great the opposition to any such radical change as this would be. When it was attempted to put it into active practice and to save the pioneers from being crushed, it ought not to be commenced until the scheme shall have been universally agreed to. It is only a question of time and agitation. Yes. The proposed selection of the prime meridian is very well made. As it will not interfere with the computations made for the Nautical Almanac, and with the zero of longitude at Greenwich. Section 1.—For scientific observations only. Railroads may use it as connected with local time. Sec. 2.—The basis of standard time is determinable any where
109	John B. Hamilton.....	
110	Henry F. MacLeod	
111	Jacob M. Clark.....	

REPLIES.

47

QUESTION 5.

QUESTION 6.

109 Yes No.

110 Yes. See page 4..... No. Prefer the hour meridians.

111 Negative..... Negative.

No. Am. Soc. C.E.	NAME.	QUESTION 4.
		and is already sufficiently established. It is the mean solar day for civil time, and astronomy requires sidereal time also. Secs. 3 and 4.—The prime meridian for longitude to be common to all nations and established for general concurrence. Sec. 5.—The prime meridian to be the best one obtainable for all scientific use, with reference to geognosy, geodesy, metrology and physical geography included. The longest accessible are for the future. The zero meridian to practically avoid habitable regions. Secs. 6 and 7.—Meridians one hour apart (whatever the length of the hour) to be designated by letters. Secs. 9 and 10.—Cosmic time for special use : local time for general. Sec. 11.—"Cosmic" time should be distinguished by letters. Sec. 12.—The letters the same as on the meridian, one metrical hour apart. Secs. 13 and 14.—No. Sec. 15.—The cosmic, local, astronomical and sea day to begin and end at midnight. The civil year and civil date at cosmic midnight and uniform the world over. Secs. 18 and 22.—Nautical and astronomical date to be the same. General answer negative. The plan proposed is in my judgment simple and comprehensive. The scheme seems simple and practicable. Yes. As a whole it is a move in the right direction, but I doubt whether any particular benefit to the people at large would accrue in the transportation by rail or water of freight or passengers. It would, no doubt, prove a benefit particularly to through or local lines connecting therewith. Yes. Many. It does. The establishment of the cosmic day and the distinguishing of its hours by the letter of the standard meridian at which it is noon, seem very commendable features. Yes, many; chiefly definiteness, comprehensiveness and simplicity. No. All the features of the plan proposed seem to be desirable.
112	George C. Wilkins.....	
113	H. P. Dwight.....	
114	William F. Bradbury.....	
115	S. L. Werden.....	
116	T. W. Pearl.....	
117	M. Giddings.....	
118	R. R. Cal.....	
119	J. W. Mallett.....	
120	Fred. T. Newberry.....	
121	D. Hudson Shedaker.....	

QUESTION 5.

QUESTION 6.

- 112 No No.
 113 Yes
 114 Yes No.
 115 No No.

- 116 No No.
 117
 118 Yes ; a smaller number of standards would be apt to create confusion as regards local business, more especially in the period of transition from the old ac-system to the new standard. See No. 5.
 119 Yes No.
 120 No No.
 121 Yes No.

No. Am. Sec C.E.	NAME.	QUESTION 4.
122	Edwin Gulpin.....	The scheme seems generally to be the best.
123	John Twigg.....	I have perused the scheme as mentioned on page 28 and the succeeding pages, and I fully concur with it, and hope that it will be carried out.
124	F. P. Dunnington	Am of opinion that the scheme of Ques. 5 if adopted by the R.R. of the Trunk lines only, will so commend itself that there will be nothing more required to cause its adoption by all newspapers, etc.
125	Francis H. Smith.....	It does; almost all of its features are such as I would approve. I should like, however, that some designation of the standard time, Q. R., etc., should be adopted, which would preclude it being called the 'local time,' for points of its time not situated on the standard meridian itself. Local time has a definite and valuable meaning, which I trust it is needless to abandon; so, too, brief and appropriate names for the errors of a clock on cosmic standard and local time would be very acceptable and useful, (e.g. 'cosmic error,' 'standard error,' 'local error,' apparent or mean.)
126	Clarence J. Blake.....	Yes.
127	Wm. M. Thornton	See below.
128	Albert Chapman Savage.....	Yes, in its general scope, and in almost all its details, it would seem to be as nearly perfect as is possible.
129	M. C. Fernald	Several.
130	John H. El.....	Yes.
131	E. Fon	I prefer 24 meridians numbered from 1 to 24, to correspond with the 24,000 miles of the earth's circumference and diurnal revolution of the earth at the rate of 1,000 miles <i>per horam</i> nearly; and the exact time to be determined at the central or cosmic observatory as proposed on page 12. The numbers—capital letters or Arabic figures. The designations of the meridians by letters A, B, C, etc., would not serve the memory or aid simple calculations of place and time so well as the Roman numerals I, II, III, IV, V, VI, etc., or the Arabic 1, 2, 3, 4. Greenwich should be the central observatory because the latitude and longitude of it is the most generally used and the best known by the largest number of navigators, ex-

QUESTION 5.	QUESTION 6.
122 Yes	No.
123 I do	I do.
124 Yes	No.
125 ———	In view of the other remark I would prefer two standards, or even one.
126 ———	———
127 Yes	No.
128 ———	Yes, only making R & T the standards for reasons hereafter given.
129 I favor standards of time differing by hourly intervals.	I do not.
130 ———	———
131 No. It would make the matter too complicated and unintelligible to any but professional savans.	No. There should be but one zero of time latitude and longitude.

No. Am. Soc C. E.	NAME.	QUESTION 4.
		plorers and merchants on earth ; and all the calculations of time and place have been made from Greenwich as the zero for the greatest lapse of time, and it is in the keeping of a government whose possessions in all the zones belt the entire globe, and which consequently is the most deeply interested in having all the calculations of time and locality the most accurately made. The general features of the scheme seem to me very meritorious. (For criticism of them see reply 11) In particular I object to any designation of meridians by letters of the alphabet. Because they conceal the distances apart of the meridians, it is difficult for me to tell how many hours there are between H and T. I demand the designation of meridians by number, because I can tell by inspection their distances apart. Thus from 23 hours of longitude to 9 hours of longitude is just a 10 hours' interval. I object especially to the use of the English alphabet (with the omission of two letters) because that at once gives a local character to the scheme. Here in Mexico which is explicitly included in the initiation of the system, we use an alphabet of 27 letters, which does not contain W but does contain <i>ch</i>, <i>ll</i> and <i>n</i> not in the English alphabet. Numerals are uniform in France, Russia and all civilized countries. On the other hand, Russia, with a peculiar alphabet, is the one European country where the scheme has been favorably received. I consider as necessary to bring all the nations meanwhile to the adoption of the cosmopolitan, not national meridian which will be used to the establishment of all the longitudes of the world and of the hour.
132	Fred. Brooks	
133	N. Bouthillier de Beaumont ...	
134	Andrew Ingraham.....	_____
135	Joseph Frutch	_____
136	Alex. S. Christie.....	_____
137	E. P. Haunaford.....	_____

QUESTION 5.

QUESTION 6.

132 Yes. I am under the impression that that will give 5 or 6 standards for the whole of North America without including Greenland or Alaska.

No. That would neither accomplish uniformity nor suit local convenience; it attempts to 'straddle' and fails.

133 Yes. For the division by hours.

No.

134	_____		_____
135	_____		_____
136	_____		_____
137	_____		_____

		QUESTION 7.
No. Am. Society, Civil Engineers	NAME.	<i>Do you prefer having only one Continental Standard, say Meridian S., and having one uniform time throughout the whole of North America? (See 21 page 31.).</i>
1	W. J. McAlpine, M. I. C. E.....	No.
2	M. D. Becker.....	No.
3	Mart. W. Harrington	
4	H. T. Eddy, Ph D....	I prefer the single meridian for the continent.
5	Robert Fletcher, Ph.D.....	No.
6.	P. H. Philbrick.....	
7	E. A. Doane.....	No.
8	Henry B. Richardson.....	I prefer this to the plans suggested in questions 5 and 6.
9	Clemens Hershel.....	No.
10	H. Stanley Goodwin.....	No.
11	Robt Briggs.....	No.
12	S. Spencer.....	I prefer four standards.
13	C. B. Comstock, Lt. Col. Engineers, U. S. A.....	No. Not practicable for daily life; of interest mainly to astronomers, who can arrange it for th mselves.
14	M. S. Greenough.....	No.
15	Jas. R. Maxwell	
16	W. A. Doane.....	No.
17	Francis J. Lynch	Yes.
18	James H. Rowan.....	No.
19	B. M. Harrod.....	No.
20	W. A. May	No.
21	C. S. Master.....	Yes.
22	James Hall, D.P.S.	Yes.

QUESTION 8.	QUESTION 10.
<i>If the scheme set forth in the document referred to (page 28) does not generally meet with your approval, is there any other scheme which you prefer? Please explain your preference for the information of the Committee.</i>	<i>In order to secure perfect uniformity and accuracy, do you favor the proposal to have Standard Time Disseminated throughout the country by Central authority controlled by government (Page 30.)</i>
1 ———	Yes.
2 I cannot think of anything that would seem as well or better than the scheme proposed in the pamphlet	Yes.
3 ———	
4 ———	I not only favor it but think it essential to make the reform a practical success.
5 No suggestion presents itself to my mind which would be any improvement on the scheme presented as a whole in regard to details. My views are stated below.	Yes; by all means:
6 I like the scheme, but I would have everything on the decimal plan—10 hour in the day, 10 meridians, 100 minutes in an hour, &c.	I do.
7 Approved	Yes.
8 ———	Of course.
9 ———	Yes.
10 I approve this scheme.	Yes.
11 ———	By all means.
12 ———	Yes.
13 ———	It might be given by the U. S. for a few controlling points in each state.
14 ———	Yes.
15 ———	
16 ———	Yes.
17 ———	I consider government control absolutely necessary.
18 The scheme generally meets with my approval. But I should like to see for strong reasons (which I could give were time placed at my disposal) the prime meridian placed as previously stated and the lettering of the others changed to suit, that is Great Pyramid Z.	I do.
19 If the above scheme is departed from I prefer one standard for the world fixed at meridian S.	Certainly.
20 ———	I do.
21 ———	
22 I prefer no other and am quite pleased with this.	Yes.

No. Am. Soc C.E.	NAME.	QUESTION 7.
23	Arthur S C. Warteles.....	For Railroad purposes it would be advantageous.
24	W. A. Sweet.....	No.
25	Wm. T. Jennings.....	I do not.
26	M. G. Howe.....	Yes.
27	Robt. H. Sayre.....	I do not.
28	Robt. Moore	No.
29	J. Foster Crowell.....	—
30	John Notman ...	? think it too few, and fancy the hour intervals would be of sufficient general benefit.

QUESTION 8.

QUESTION 10.

- 23 Let one meridian be fixed on for Railroad time, but do not undertake to interfere with local time. Clocks with double dials could be used with different colours so as to avoid confusion.
- 24 This meets my approval in every way, and I will do all I can to aid in its being carried out.
- 25 The scheme proposed on page 28 appears most complete, and is evidently the result of careful study.
- 26 The scheme as referred to in questions 7 and 10 is the best that now occurs to me.
- 27 —————
- 28 As before stated—in 4—I approve the scheme and have no other to suggest.
- 29 It generally meets my approval....

I do not believe in constantly calling on government it will end in curfew.

Most certainly by the Government.

I do.

Yes.

I do.

This method seems the best.

Yes. Provided there should be a number of national observatories in different parts of the country of course in communication with one another to check results and provide against interruption.

Certainly, have some authoritative security.

- 30 I would be willing to keep the dials as at present to prevent enlargement to inconvenience, for we have no difficulty in night and day discernment, and it might be unwise to create changes that would bewilder the illiterate great majority, but I advocate a prime meridian for the whole world. A 24 hour diurnal computation of one hour in ervals, and these are the two grand attainments with me. These two points have become an almost necessity. The great regard now exercised for the maintenance of human life; the general objection to the settlement of national disputes by war; the rapid facilities afforded and adopted for enlargement in knowledge, practical and theoretical, tend to fulfil the prophecy of scripture, viz: that the time will come when "a nation shall be born in one day."

The facilities, and even inducements afforded for travel, are fostering an inherent disposition in us to that result, viz: of seeing and visiting other localities, and in so doing every one experiences the inconvenience through the variance of local time,

No. Am. Soc. C.E.	NAME.	QUESTION 7.
31	T. J. Potter.....	See query 6
32	W. B. Smellie.....	_____
33	Stephen S. Haight.....	No.
34	Julius W. Adams.....	No.
	Past Pres. Am. Soc. C. E.	
35	F. N. Gisborne.....	No.
36	James H. Harlow.....	_____
37	A. B. Cox.....	_____
38	Edward S. Philbrick.....	I think this would be objectionable by
		making the time on the west coast differ
		so much from apparent time as to lead to
		various inconvenience.
39	Moncure Robinson.....	I do.
40	Kivas Tully....	No.
41	T. H. Perry.....	I do most assuredly.

QUESTION 8.

QUESTION 10.

I visited Chicago last week and on my arrival there, and as I intended to remain there for a few days, I realized the propriety of finding the difference between my watch and the hotel clock I walked off and when, intending to return, consulted my watch. The difference was so much, but the difficulty arose as to the direction. Was it slow or fast? A geographical reflection solved the doubt, but how many travellers are ignorant in that respect! The local time difficulties are so frequent, so continuous and so embarrassing as to require no exposition from me, and a remedy would doubtless be a most important reform.

31 Answered under 5.....

Would be in favor of Government determination of time at meridians. Think this highly desirable.

32 The scheme set forth generally commends itself to my judgment.

Yes.

33 In the division of the day into hours if letters were used for the forenoon hours, as well as for the afternoon, there would be a great advantage derived from the uniformity of all time keepers in the world, they being so made that their hour hands would make one revolution in 24 hours.

34 There is none.

No other means would be effectual but Governmental.

35 No.....

Yes.

36 I have not given sufficient thought to the subject to either object or suggest any other scheme.

Yes.

37 —————

It depends on what the control authority is.

38 The simplicity of this scheme will, I think, recommend itself to all intelligent persons, at least to all those who value the elements of certainty and accuracy which it contains.

By all means Government would be the proper source, and should do the work at public cost.

39 I have no preference for any other scheme.

I do, provided such control be constitutional.

40 Approve of scheme page 28.....

Yes.

41 It does, except the establishment of more than one meridian in this country will be "confusion worse confounded."

Yes, it is the only true way.

No. Am Sec. C.E.	NAME.	QUESTION 7.
42	J. W. Putnam.....	I do not.
43	Charles H. Swan.....	Yes, for railroad time. The use of Q. R. S. & T., or U. & R, will merely modify the present confusion, the use of a single meridian will remove it entirely. See reply 11.
44	Sir Charles Tupper.....	Yes.
45	Jos. P. Davis.....	No.
46	P. S. Archibald.....	No.
47	H. E. Stevens.....	No.
48	B. S. Henning	Yes.
49	J. Milton Titlow.....	Yes.
50	Wm. A. Norton	_____
51	C. A. Young.....	No.
52	Robert A. Shailer	No.
53	L. B. Archibald	Prefer one standard for the globe say meridian Z.
54	F. P. Stearns	No.
55	C. S. Davidson.....	No.
56	Edward Maguire	No.
57	E. G. Ferris.....	No.
58	Collingwood Schreiber	Yes.
59	Henry Gannett.....	_____
60	James P. Howley.....	I do not think this plan would be so convenient as the hourly standard.
61	E. P. Alexander	Same objection as above only more so, though <i>individually</i> I would prefer this. But it would certainly be harder to introduce and have understood.

QUESTION 8.

QUESTION 10.

42 —————

I think so, and corrections made at h
point for longitudinal difference, and l-
ded to or subtracted from the time given.
Yes.

43 See reply 11.....

44 I think the scheme suggested will
meet the requirements fully.

Yes.

45 —————

46 No other I prefer.....

Yes.

47 I would prefer to have standard
time numbered instead of lettered.

Yes.

48 —————

49 The scheme of standards is very
good ; but think it would be better to
have one standard time extend over
a larger geographical area. Say one
standard time S. for N. America 2
for S. America and say six others on
Eastern Hemisphere fixed by the
standard passing through the middle
of a large and well defined geographi-
cal area.

No.

Yes.

50 —————

Yes.

51 No

Yes.

52 —————

Yes.

53 —————

Yes.

54 —————

Desirable but not an important feature
Local time balls which drop within a
fraction of a second answer the purpose,
as well as those controlled by Government.
Controlled by Government.

55 —————

Yes.

56 —————

Yes standard time would be useless
without Government control.

57 —————

Yes it appears to me to be the only
practicable way of having it done.

58 No.....

Certainly.

59 —————

I think it would be absolutely neces-
sary to have such a plan adopted other-
wise it would be almost impossible to
disseminate it.

60 —————

That would be best:

61 The scheme meets my cordial appro-
val. As Vice-President of L. & W:
Road, I have long contemplated an
earnest effort to unite all roads east
of Mississippi River, in use of Wash-
ington city time for all time tables.
But this scheme is preferable. It
seems to me, too, that if even only two
or three of the largest R. R. systems of

No. Ans. C.E.	NAME.	QUESTION 7.
62	W. H. Wood	No.
63	F. M. Towar	No.
64	Julius J. Durdye.....	Yes.
65	Thomas S. Sedgwick.....	I do not.
66	George M. Dawson.....	Would suggest the adoption of this plan or the use of twice, as many meridians as suggested in Question 5. The latter plan would render it sufficiently near local time for all practical purposes.
67	T. C. Mendenhall.....	No.
68	L. J. LeConte	No.
69	Edward C. Pickering.....	No.
70	H. F. Royce.....	No.
71	J. S. Sewall.....	No.
72	Wm. B. Hazen, Maj. Gen. U.S.A..	Yes; meridian S.
73	J. M. Buchan.....	No.
74	George Kennedy.....	No.
75	E. D. Ashe.....	Yes.

QUESTION 8.

QUESTION 10.

the U.S. will begin at once and adopt the system, it will rapidly spread. The "Division into Hours" part of it need not necessarily be adopted at once, as on that there may be less unanimity.

62 ———

63 The scheme set forth on page 28 meets my approval.

64 ———

65 I prefer the suggestion made on pages 18 for the U. S.

Eastern Time	Newfoundland:
Atlantic Time, Meridian of New York.	
Valley " "	New Orleans.
Mountain " "	Denver.
Pacific " "	Santa Barbara

This is a matter of nomenclature.

66 ———

67 I have always favored the adoption of meridians one hour apart as likely to lead to the least confusion, and the most likely to be generally acceptable to the masses of the people.

68 I approve of said scheme in all respects except as above mentioned in reply 4.

69 ———

70 ———

71 ———

72 The practical difficulty in deciding upon the lines of division through a well settled country (which is not met by paragraph 19, page 30) renders advisable the adoption of a single meridian for the whole of North America.

73 ———

74 I have no other scheme to propose.

75 It does generally, with the exception of the—to me—unnecessary complications of standard meridians—Z to R. If a change is made let us at once adopt the most simple method of a universal standard time.

Yes.

Yes.

Yes.

Yes, to be transmitted electrically to each standard.

Yes.

Yes.

Yes, for the only reason that I believe that it would be cheapest and most reliable.

Probably more accurate time could be furnished by co-operation of local observatories, but avoiding effects of local storms.

Yes.

Yes.

This is not necessary; the co-operation of the several astronomical observatories would be advisable.

Yes.

Yes.

Certainly not, knowing, as I do, the impossibility of depending on telegraph connection over large distances and at an exact instant.

Establish the difference of longitude of several important points from the prime meridian; and let these points distribute the universal time to as great an area as possible.

No. Assoc. C.E.	NAME.	QUESTION 7.
76	Wm. P. Judson.....	No.
77	Wilson Crosby.....	No; not at present.
78	W. H. Pratt.....	This would not be as readily accepted.
79	George S. Gatchell.....	I do not.
80	H. S. Pritchett.....	It seems to me not feasible at the present time.
81	C. J. Ives.....	Iowa being in S would prefer all to come to our time.
82	Asa Horr, M.D.....	Yes.
83	J. L. Gillespie.....	No.
84	Wm. P. Anderson.....	The objection stated in reply 6 would apply with greater force.
85	Rufus Ingalls.....	The four standard meridians seem the best system.
86	W. E. Jacobs.....	No see above.
87	Winslow Upton.....	By all means.
88	H. A. Howe.....	Most certainly not.
89	D. R. Taylor.....	No.
90	J. R. Eastman.....	I am strongly in favor of only one standard of time for the United States.
91	Jas. R. Barber.....	See answer to No. 8.

QUESTION 8.	QUESTION 10.
76 Scheme seems complete as given.	Yes, through the medium of the signal service.
77 ———	Yes.
78 ———	This is no doubt the best, indeed, probably, the only feasible, efficient method.
79 The scheme set forth meets my approval.	Yes, sir.
80 ———	No. This work can undoubtedly be best done by the separate observatories.
81 ———	Yes.
82 I cannot conceive of any other scheme that could be preferable to that already outlined.	Yes.
83 ———	It can be done in no other way.
84 ———	It is the only way in which it could effectively be inaugurated and carried out Yes.
85 Having no other scheme before me with which to make comparison I would say the scheme presented meets with my approval.	Yes and made compulsory on all transportation companies.
86 See at present no scheme preferable to the one prepared by Mr. Fleming.	No, but by the several astronomical observations.
87 One continental standard is preferred: among the reasons for the preference are :	
1. It would be the simplest plan.	
2. It would commend itself to transportation companies, and be adopted by them at once.	
3. It would <i>gradually</i> come into use by the people at large.	
4. When once in use there would be no confusion at the division lines.	
88 ———	On account of the vast extent of the country I think it would be best to have at least one time station for each meridian. Each station should be under governmental control.
89 ———	Yes.
90 I am in favor of a <i>single</i> standard time, for all transportation purposes in the U. S. Local time is now used, and always will be for domestic purposes. An arbitrary standard, is always used for transportation purposes, and the multiplicity of these standards is the source of all our difficulties.	This cannot be done by the method now in vogue without enormous expense. Some occasional check should be employed, but all good observatories would be competent authority in their respective localities.
91 Why have both 'cosmic' and 'local' time? Would it not be preferable to retain the first alone and make clocks the world round point to the	By all means, if possible connected with the signal and meteorological service and controlled by it.

No. Am. Soc. C.E.	NAME.	QUESTION 7.
92	Simon P. Newcomb.....	If not four—use one ; cannot say which is easier.
93	DeVolson Wood.....	I do prefer one standard of time.
94	W. F. Ellice	No.
95	Alex. Murray	I think that hourly standards or 15° of longitude should be permanently established.
96	Edwin A. Hill	See reply to Question No. 6.
97	C. D. Ward.....	
98	M. C. Meigs, Brig .Gen U.S.A...	No. It would be inconvenient to the millions, and be advantageous only to R.R., and R.R. travellers.

QUESTION 8.

QUESTION 10.

same hour at the same moment of absolute time? I am perfectly aware that this would seriously disarrange our ideas that are so fixed with reference to noon coming at 12 o'clock; but people would soon get used to mid-day coming at 4 or 7 o'clock as the case might be. After studying the question I think the disadvantages would be out-weighed by the advantages.

92 The easier and simplest plan is to take either New York or Washington time as the standard, and if necessary use these subsidiary meridians each differing an integral number of hours from the standard

93 Not having the document at hand just now, I can not reply, but have a remark under Q. 11. It seems to me that the objections to several standard meridians 24 are so numerous and so strong I hope the scheme, will find little if any favour.

94 -----

95 -----

96 See replies to questions Nos. 4 and 5. To the objection urged at Washington that 30 minutes is too great a departure from local time for the masses, etc. I had thought that if the objection were likely to prevent the adoption of the system of page 28 subordinate standards of 10 minutes each could be used by the common people for local affairs, and the hour standards by the Railroads thus reducing all differences of time to multiples of 10 minutes. But I should prefer the system of page 28 if the people could hereafter be induced to adopt it.

97 -----

98 I like the meridian of Greenwich or 180° therefrom. The day cannot, in popular use, be made to conform to the astronomical, or sidereal, or sea day. All these are inconvenient to the former. His day is the day through which he works and wakes only.

This is very desirable.

It would hardly be possible to carry out the plan without co-operation of the Government

By all means.

Yes, but if the changes are too radical the system will progress but slowly as is the case of the metric system of weights and measures; and hence while universal time signals transmitted would always be desirable, legislation looking to the compulsory adoption of standard time by the masses could not be enforced against their will.

Yes.

Yes. The national naval observatory at Washington is prepared with the means of determining time with all possible accuracy. It already drops some time balls, and would drop them in every city if the society will procure from Congress the money to pay for the work and the instruments.

No. Am. Soc C.E.	NAME.	QUESTION 7.
99	Julius Pohlman.....	No. For the same reason as above.
100	J. C. Wood.....	Yes. One uniform time for transportation and commercial purposes only.
101	Lewis Bass.....	—
102	Melville Dui.....	I would keep all skemes (sic) [sic] out of sight except pure cosmic lettered A.-Z. and the 24 meridian.
103	Chas. A. Scott.....	I consider this is unadvisable and impracticable for ordinary local business transactions and common affairs of life.
104	David H. Jerome.....	Possibly ultimately.

QUESTION 8.

QUESTION 10.

- 99 All the foregoing answers are given in the expectation of a standard time for America.
- 100 A uniform time. Say meridian S for transportation and commercial purposes, but localities to regulate their time by their distance from meridian S.
- 101 —————
- 102 Masses will (*sic*) rebel against (*sic*) a system that brings noon an hour or more out of the true noon. The 15° change is always within 30 min. and will be accepted readily. If there is to be a compromise let it be by all means on 8 main meridians i. e. each 45°. This harmonizes with the centesimal system likely to prevail in future generations and gives us S for N Am. standard.
- 103 I do not favor the scheme proposed, it does not strike at the root of the evil, puts the majority of the population between any two lettered meridians to constant and intolerable inconvenience; since near the boundaries they may be in discord with the sun $\frac{2}{3}$ of an hour or $\frac{1}{2}$ hour maximum of equation of time or 16 minutes, and will find themselves an hour out in intercourse with their neighbours. Confusion in running railway trains across the hourly boundaries still exists.
- 104 Have nothing more to suggest than is embraced in your documents.

Yes, if we are to obtain any results.

Yes.

By no means. Time can be furnished from various centres with greater convenience and accuracy, and with less expense than from a single one in a country as large as this. In my opinion the recommendation of a single centre for distribution of time would be fatal to the whole scheme.

Strongly.

Yes. By the national observatory at Washington for the dissemination of Greenwich time.

The Signal Service should undoubtedly be, as it is now to a certain degree, the principal agents in the distribution of correct time, but in order to have this new system generally adopted it would need, primarily and principally, to be adopted by the railroads. The co-operation of the principal business centres would also be, of course, necessary. Local jealousies will doubtless impede its introduction. I think it would be impracticable to introduce at once one Standard Continental Time. Although

No. Am. Soc C. E.	NAME.	QUESTION 7.
105	W. T. Sampson	I prefer having a single standard for each continent to be used by railroads, steamboats and telegraphs.
106	Ormond Stone.....	_____
107	H. S. S. Smith.....	No.
108	W. Brydone-Jack.....	Yes. East of S. designated as above and referred to Greenwich S. designated D ⁰ and hour meridians next or D ¹ D ² D ³ D ⁴ D ⁵ .
109	John B. Hamilton.....	No.
110	Henry F. MacLeod, M.I.C.E.....	No.
111	Jacob M. Clark.....	Negative.
112	George C. Wilkins.....	Yes, meridian S, 90° from Greenwich.
113	H. P. Dwight.....	No.
114	William F. Bradbury.....	Yes, but that the meridian which traverses the greater distance on land and subserves the interests of the greater producing section which is bound to be the power sooner or later say meridian T.
115	S. L. Werden.....	
116	J. W. Pearl.....	Yes.
117	M. Giddings.....	Think this most desirable.
118	R. R. Call.....	See No. 5.

QUESTION 8.

QUESTION 10.

105 I prefer that each continent should have a single standard to be used for purposes of communication to be regulated from a central observatory which shall also regulate the local time of every place of importance. The standard of each continent to differ by an exact number of hours from the other.

106 ———

107 I think of no change.....

108 ———

109 I think well of the plan.....

110 Can suggest no improvement.....

111 The difference between local and cosmic time is so simple, and the devices by which the perfect knowledge of its nature and amount may be diffused everywhere are so ready and inexpensive that effort in that direction after a prime meridian shall have been adopted would in accordance with the answer I have given, very soon extinguish the main difficulties.

112 ———

113 ———

114 ———

115 It meets my views to a certain extent, but the advantages are confined and only available to a class of citizens who are very well satisfied at present other than the establishing of a standard of time which is only of moment to the professional and travelling community.

116 ———

117 ———

118 ———

possibly this would be the better way in the end, and could perhaps be ultimately introduced if the first plan is found to gain popular favor. I favor this plan.

I favor this plan.

No. By no means.
Yes, but should have a number of observatories to prevent interruptions.
Yes.

Under naval observatory, yes; if a new bureau is to be created, no.

Yes. Consider this a matter of great importance and convenience to all classes, especially to railway and telegraph companies, surveying operations, &c.

Negative under reply 8: such local or district local standards, if any should be required, would be best regulated by the people according to their needs. Railroads, &c., could be safely run by either cosmic or local time as advertised. But the diffusion of knowledge on the subject should be aided by Government.

Yes.

Yes.

Yes.

Yes, and at the expense of Government.

Yes.

By all means the best and most effective.

Without Government control the standard would be difficult of maintenance and would soon become a mere *nominis umbra*.

No. Am. Sec. C.E.	NAME.	QUESTION 7.
119	J. W. Mallet.....	No.
120	Fred. T. Newberry.....	Yes, adopting the meridian of Wash- ington Observatory.
121	D. Hudson Shedak r.....	No.
122	Edward Gilpin.....	No.
123	John Twigg.....	Most certainly I do.
124	F. P. Dunnington.....	No.
125	Francis H. Smith.....	One.
126	Clarence J. Blake.....	Yes.
127	Wm. M. Thornton.....	No.
128	Albert Chapinan Savage.....	
129	M. C. Fernald.....	I think a single standard would be objectionable.
130	John H. Blake.....	Y.
131	E. Fontaine.....	Yes, that <i>continental</i> standard is to serve for all nations I think there should be but <i>one</i> standard and that ought to be <i>telluric</i> to be international; only one is necessary, and I prefer M or Greenwich to S, making my national pride and pre- judice bow to the welfare of all nations.
132	Fred. Brooks.....	No. I think that for some purposes only one cosmopolitan standard and uni- form time throughout the whole world may be used and that would not be meridian S. For local purposes I believe as many as 24 standards needed.
133	N. Bouthilier de Beaumont.....	No.
134	Andrew Ingraham	—
135	Joseph Trutch.....	—
136	Alex. S. Christie.....	—
137	E. P. Hannaford	—

QUESTION 8.

QUESTION 10.

- 119 ———
- 120 Preference for a standard time for
Railroads, Steamboats, &c, on which
the day from midnight to midnight
is divided into 10 parts. All sub-
division being decimals thereof. Local
time not to be interfered with.
- 121 No preference for any other scheme.
- 122 ———
- 123 I am perfectly satisfied with the
scheme mentioned on page 28.
- 124 On the whole I prefer the proposed
scheme, yet I append under reply
No. 11 quite a serious objection not
met in this scheme.
- 125 ———
- 126 ———
- 127 ———
- 128 ———
- 129 The scheme I regard a good one,
but suggest consideration of a single
feature of it presented in reply to
No. 11.
- 130 It does meet my approval.
- 131 The general scheme of the commit-
tee is excellent, and I have nothing
better to offer than a condensed
electicism of the whole plan, which
only needs the addition of details for
practical use.
- 132 ———
- 133 Opposed to the division by 24 hours
instead of 12 so useful in our relations.
- 134 ———
- 135 ———
- 136 ———
- 137 ———

Yes
Yes.

Yes.
Yes.
Yes.

The private interests of railroads would
render U. S. aid unnecessary.

I do.
Yes.
Yes.
Yes.

Such a system of disseminating time is
very desirable.

Yes.

Yes, just as the Government regulates
the currency and as it should control
navigation commerce, the inter-state, and
international telegraphic and railway
lines and prevent their corrupt and
injurious management by swindling and
oppressive rings and monopolies.

I don't know about the Mexican and
Canadian Governments, but I object, as a
proud citizen of the U. S. A. having my
Government undertake this business.
The separate State Governments may if
they like. The National Government
does not regulate the clocks of the coun-
try. It buys what it needs for its own
use like any other corporation. It should
use the cosmopolitan time, as it probably
now uses good clocks in preference to
poor ones. But the setting of clocks
right every twenty-four hours as well as
the manufacture of clocks that will go
uniformly seems to belong to science and
not to politics, and not to be provided
for in the constitution.

I do not find necessary the control
of Government.

QUESTION 9.—Referring to the suggestions under the heading "Division of the Day into Hours" (page 31) please indicate which of the three following plans you prefer.

No. Am. Society, Civil Engineers	NAME.	(A) The alternative plan No. 1, with the hours, numbered from 1 to 24 without interruption.
1	W. J. McAlpine.....	Yes.
2	M. D. Becker.....	Yes.
3	Mart. W. Harrington	Prefer this plan.
4	H. T. Eddy, Ph. D.....	Prefer this system.
5	Robert Fletcher, Ph.D.....	This is the best plan for popular use.
6	P. H. Philbrick.....	I prefer this, but with 10 hours per day.
7	E. A. Doane.....	Prefer this one.
8	Henry B. Richardson.....	I prefer this plan, No. 1.
9	Clemens Herschell	This plan, but modified thus: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 12-1, 12-2, 12-3, etc., o'clock. It would be awkward to say 22 o'clock, but 12.10 o'clock is easier said and understood.
10	H. Stanley Goodwin.....	Yes.
11	Robert Briggs	Numbers merely 1 to 24.
12	S. Spencer.....	I prefer plan 1.
13	C. B. Comstock, Lt.-Col. Engineers, U. S. A.....	This plan.
14	M. S. Greenough.....	No.
15	Jas. R. Maxwell.....	Yes.
16	W. A. Doane	I think this preferable.
17	Francis J. Lynch.....	I consider that numbering from 1 to 24 would be the best plan.
18	James H. Rowan.....	I prefer this plan.
19	R. M. Harrod.....	One to twenty-four.
20	W. A. May.....	No. 1
21	C. J. Master.....	Would be inconvenient.
22	James Hall, D. P. S.....	Would prefer 1 to 24.
23	Arthur E. C. Wurtele.....	I prefer the renumbering of hours from one to twenty-four.
24	W. A. Sweet.....	Yes.
25	Wm. T. Jennings.....	I prefer this.
26	M. G. Howe.....	Plan No. 1 seems to me the best.
27	Robt. H. Sayre.....	I regard this the best.
28	Robt. Moore	Would retain the present dials.
29	J. Foster Crowell.....	
30	John Notman.....	
31	T. J. Potter.....	Can see no solid objection to prevent method of numbering from midnight and noon.

QUESTION 9.—Referring to the suggestions under the heading "Division of the Day into Hours" (page 31) please indicate which of the three following plans you prefer.

(B) The alternative plan No. 2, with the forenoon hours numbered as at present and the afternoon hours lettered as described !

(C) The present division into half days, known as forenoon and afternoon, each half day having the hours numbered identically from 1 to 12 !

- | | |
|---|---|
| 1 No | No. |
| 2 No | No. |
| 3 ——— | ———— |
| 4 ——— | ———— |
| 5 Not to be preferred to A. The advantages of B are more than met by the simplicity of A. | This should be abandoned in any case. |
| 6 Don't like it. | Don't like it. |
| 7 ——— | ———— |
| 8 ——— | ———— |
| 9 ——— | ———— |
| 10 No..... | No. |
| 11 The alphabet arrangement could not be fixed. | ———— |
| 12 ——— | ———— |
| 13 ——— | ———— |
| 14 No..... | Yes. |
| 15 This is preferable | ———— |
| 16 ——— | ———— |
| 17 Decidedly objectionable..... | ———— |
| 18 ——— | ———— |
| 19 ——— | ———— |
| 20 I prefer this..... | ———— |
| 21 ——— | ———— |
| 22 ——— | ———— |
| 23 Would be absurd..... | Don't see anything new in that. |
| 24 ——— | ———— |
| 25 ——— | ———— |
| 26 No | No. |
| 27 No sir | No. |
| 28 Inferior to plan No. 1..... | Inferior to plan No. 1. |
| 29 Too complicated..... | A relic of ignorance. |
| 30 ——— | Yes; retain as much of the present system as possible without serious conflict. |
| 31 ——— | ———— |

No. Am. C.E.	NAME.	QUESTION 9.—A.
32	W. B. Smellie.....	The hours numbered from 1 to 24.
33	Stephen S. Haight.....	
34	Julius W. Adams..... Past Pres. Am. So. C. E.	This by all means.
35	F. N. Gisborne.....	Yes.
36	James H. Harlow.....	Yes.
37	A. B. Cox.....	The rotation of the hours can be changed at any time, and it would be better to leave it alone until a standard time can be secured.
38	Edward S. Philbrick.....	This is good enough, and has already been used and tested a long time in Italy, &c.
39	Moncure Robinson.....	Numbered from 1 to 24. From 1 to 24.
40	Kivas Tully.....	
41	T. H. Perry.....	
42	J. W. Putnam.....	I think this plan or divided into 20 hours preferable, and if practicable, the hours to contain 100 minutes.
43	Charles H. Swan.....	Possibly.
44	Sir Charles Tupper.....	I have preference for this.
45	Jos. P. Davis.....	I prefer plan No. 1.
46	P. S. Archibald.....	This plan I prefer.
47	H. E. Stevens.....	Yes.
48	B. S. Henning.....	Yes.
49	J. Milton Titlow.....	Prefer the above.
50	Wm. A. Norton.....	Yes, for some purposes.
51	C. A. Young.....	
52	Robert A. Shailer.....	I prefer plan 1.
53	L. B. Archibald.....	I prefer plan A.
54	E. P. Stearns.....	Yes.
55	C. S. Davidson.....	I concur.
56	Edward Maguire.....	Yes.
57	E. G. Ferris.....	I prefer this.
58	Collingwood Schreiber.....	I prefer this plan.
59	Henry Gannett.....	Yes.
60	James P. Hewley.....	I think this decidedly preferable.
61	E. P. A. Alexander.....	I prefer this for R. R. schedules only, as perhaps possible to bring into common use.
62	W. H. Wood.....	Yes.
63	F. M. Towar.....	I favor this division of time.
64	Julius J. Duraye.....	Yes.
65	Thomas S. Sedgwick.....	This. Sec. 22, part firstly.
66	Geo. M. Dawson.....	Would prefer this plan decidedly.
67	T. C. Mendenhall.....	I prefer this plan A.
68	L. J. LeConte.....	This is naturally best.

QUESTION 9.—B.

QUESTION 9.—C.

- 32 _____
- 33 This on account of its uniformity
throughout the world.
- 34 _____
- 35 No
- 36 _____
- 37 _____
- 38 I don't appreciate the supposed
advantages of this method.
- 39 _____
- 40 _____
- 41 No
- 42 _____
- 43 Possibly
- 44 _____
- 45 _____
- 46 _____
- 47 No
- 48 No
- 49 _____
- 50 _____
- 51 No
- 52 _____
- 53 _____
- 54 No
- 55 No
- 56 No
- 57 Don't like it.
- 58 _____
- 59 _____
- 60 The lettered hours could not be in-
dicated by sound i. e. striking clocks
—a great inconvenience.
- 61 Bad. Have to say half the alpha-
bet and count all your fingers and
some of your toes to know when it
is bed time.
- 62 No
- 63 _____
- 64 No
- 65 No
- 66 _____
- 67 No
- 68 _____

- _____
- _____
- _____
- No.
- _____
- _____
- This should be abandoned, being sense-
less, and leading to confusion.
- _____
- _____
- This must be made by a mechanical
contrivance of the clock to shew both
S. and L. till communities are educated
to the one standard system.
- _____
- Should be abandoned.
- _____
- _____
- No.
- No.
- No.
- No.
- No. 1 would be an improvement.
- _____
- _____
- Let the people alone to use the present
system, but R. R. schedules may be
brought to No. 1 in time.
- _____
- No.
- No.
- No.
- Very bad.

No. Ann. Soc. C. E.	NAME.	QUESTION 9.—A.
69	Edward C. Pickering A.....	Preferred.
70	H. F. Royce.....	No. 1 most decidedly.
71	J. S. Sewall.....	Yes. If practicable to introduce it.
72	Wm. B. Hazen, Maj. Gen. U. S. A.	This is preferred.
73	J. M. Buchan.....	Yes.
74	George Kennedy.....	This decidedly.
75	E. D. Ashe.....	
76	Wm. P. Judson.....	No.
77	Wilson Crosby.....	I prefer this.
78	W. H. Pratt.....	The No. 1. By all means.
79	Geo. S. Gatchell.....	If any change is made I prefer this.
80	H. S. Pritchett.....	This plan seems to me best.
81	E. J. Ives.....	Prefer No. 1.
82	Asa Horr.....	Yes.
83	J. L. Gillespie.....	This plan decidedly.
84	Wm. P. Anderson.....	I prefer this arrangement.
85	Rufus Ingalls.....	This has the element of simplicity and is therefore preferred.
86	W. E. Jacobs.....	Prefer Plan No. 1.
87	Winslow Upton.....	Yes.
88	H. A. Howe.....	I prefer this plan.
89	D. R. Taylor.....	Yes, by all means.
90	T. R. Eastman.....	Yes.
91	Jas. R. Barber.....	I prefer this plan.
92	Simon P. Newcomb.....	Too radical for practice.
93	DeVolson Wood.....	I have decided preference for this.
94	Wm. F. Ellice.....	Hours numbering 1 to 24.
95	Alex. Murray.....	The principle is the right one, but the number of figures on the dial might be confusing and the <i>striking time</i> a difficulty.
96	Edwin A. Hill.....	This if the common people could be induced to adopt it, which I doubt. [Compare metric system.]
97	C. D. Ward.....	This plan decidedly.
98	M. C. Meigs Brig. Gen. U.S.A....	No.
99	Julius Pohlman.....	
100	I. C. Wood.....	Prefer this for railway and commercial purposes
101	Lewis Bass.....	I should favor this by all means.
102	Melvil Dui.....	No. (See No. 11.)
103	Chas. A. Scott.....	By far the preferable and satisfactory.
104	David H. Jerome.....	This by all means.

QUESTION 9. -B.	QUESTION 9. -C.
69 Not approved	Not approved.
70 -----	-----
71 No	-----
72 No	No.
73 -----	Yes.
74 No	No.
75 This has the same objection as A. M. and P. M. have.	-----
76 Yes. Except that the P. M. hours should be denoted by Roman numerals.	No. See Reply 11.
77 -----	-----
78 Perplexing and not likely to be acceptable.	This is one of the great present defects.
79 -----	-----
80 -----	-----
81 -----	-----
82 No	No.
83 -----	-----
84 This would be objectionable if only on account of the difficulty in calculating the interval between different hours.	-----
85 -----	-----
86 -----	-----
87 No	Preferred to B.
88 -----	-----
89 -----	-----
90 -----	-----
91 I think this better than C., but A. the best.	Not at all.
92 Too radical for practice	This. In time tables distinguish day and night by the type.
93 Objectionable because mixed, and would not come into use.	This is better than B.
94 By no manner of means	Present division is troubles me.
95 Might answer very well	With a double dial face, I think would be convenient.
96 Do not favor this	While I should prefer A, the reasons advanced above lead me to indicate C.
97 -----	-----
98 No	Yes.
99 -----	It would simplify its adoption everywhere.
100 Not considered practicable.	Prefer this for local time.
101 -----	-----
102 No	Temporarily this is best.
103 Objectionable as illogical	Objectionable as confusing.
104 -----	-----

No. Am. Soc. C. E.	NAME.	QUESTION 9.—A.
105	W. T. Sampson, Com. U. S. A....	I prefer plan "A."
106	Ormond Stone	
107	H. S. S. Smith,.....	In doubt.
108	W. Brydone-Jack	I prefer numbering the hours 1 to 24.
109	John B. Hamilton	"Firstly" approved.
110	Henry T. McLeod	Prefer the hours to number 1 to 24. ..
111	Jacob M. Clark	Metrical hours to number consecutively round the circle.
112	Geo. C. Wilkins	
113	H. P. Dwight	Prefer this.
114	William F. Bradbury.....	This plan.
115	S. L. Werden	
116	J. W. Pearl	
117	M. Giddings	Prefer this.
118	R. R. Call.....	
119	J. W. Mallet	Prefer No. 1.
120	Fred. T. Newberry	No.
121	H. Hudson Shedaker	I think this is the best.
122	Edwin Gillespie	
123	John Twigg	I prefer the consecutive numbers 1 to 24.
124	F. P. Dunnington	Best for railroad tables.
125	Francis H. Smith.....	I like No. 1 best.
126	Clarence J. Blake.....	This.
127	Wm. M. Thornton	I prefer plan No. 1.
128	Albert Chapman Savage.....	
129	M. C. Fernald	I regard this the best plan.
130	John H. Blake	This.
131	Ed. Fontane	I have already answered these four queries. Time should be measured by 24 divisions regardless of the various shifting shadows of the earth distinguishing night and day.
132	Fred Brooks	Yes; I prefer No. 1, because with that the intervals between different hours may be seen. From 6 o'clock to 13 o'clock is 7 hours for instance.
133	N. Bouthillier de Beaumont	No.
134	Andrew Ingraham	
135	Joseph Trutch.....	
136	Alex. S. Christie	
137	E. P. Hannafoord	

QUESTION 9.—B.

QUESTION 9.—C.

- | | | |
|-----|--|--|
| 105 | _____ | _____ |
| 106 | _____ | _____ |
| 107 | In doubt, but slightly preferable to A. | No. |
| 108 | I do not like this | I would not very much object to this, but it will be found hard to change. |
| 109 | No | No. |
| 110 | Think the letters in the afternoon would cause confusion in adjoining towns | Prefer A. |
| 111 | Negative. | Negative. |
| 112 | _____ | I prefer this. |
| 113 | _____ | _____ |
| 114 | _____ | _____ |
| 115 | Yes | _____ |
| 116 | B | _____ |
| 117 | _____ | _____ |
| 118 | The alternate plan No. 2, as most easily showing the connection between the standard of the place and the cosmic day. | _____ |
| 119 | _____ | _____ |
| 120 | No | No interference with local time. |
| 121 | No | No. |
| 122 | _____ | Yes. |
| 123 | _____ | _____ |
| 124 | _____ | This has many advantages in private life. |
| 125 | _____ | _____ |
| 126 | _____ | _____ |
| 127 | _____ | _____ |
| 128 | This seems the better plan. | _____ |
| 129 | Do not like the letters. | Not so good as A. |
| 130 | No. | No. |
| 131 | _____ | _____ |
| 132 | I object to this. If a laboring man begins to work at V and end at W, how many hours does he work? How will the clock strike W | I object to this, but insist that the local day begins at midnight, not at noon. See Sir J. Herschel's <i>Outlines of Astronomy</i> . He condemns the practice of astronomers beginning at noon. |
| 133 | _____ | Yes. |
| 134 | _____ | _____ |
| 135 | _____ | _____ |
| 136 | _____ | _____ |
| 137 | _____ | _____ |

No. Am. Society. Civil Engineers	NAME.	QUESTION 11.
		<i>Have you any particular views on the question of Time reform, not embraced in the questions and replies above given? If so, please state them for the information and guidance of the Committee. (If necessary on a separate sheet.)</i>
1	W. J. McAlpine, M.I.C.E.....	_____
2	M. J. Becker.....	_____
3	Mart W. Harrington.....	_____
4	H. T. Eddy, Ph.D.....	Nothing further.
5	Robert Fletcher, Ph.D.....	_____
6	P. H. Philbrick.....	_____
7	E. A. Doane.....	_____
8	Henry B. Richardson.....	_____
9	Clemens Herschel.....	_____
10	H. Stanley Goodwin.....	None different from those expressed in the document, page 28.
11	Robert Briggs.....	_____
12	S. Spencer.....	None except to concur in the general view that the question of uniform standard time is one of great public interest, and especially so to the railways of America.
13	C. B. Comstock.....	_____
14	M. S. Greenough.....	_____
15	James R. Maxwell.....	_____
16	W. A. Doane.....	_____
17	Francis J. Lynch, M.I.C.E.....	_____
18	James H. Rowan.....	_____
19	B. M. Harrod.....	_____
20	W. A. May.....	_____
21	C. S. Master ...	_____
22	James Hall, D.P.S.....	I have no particular view which is not introduced in the above questions and replies, except that I think if the prime meridian could be fixed at 180° from Greenwich, it would render the change easier made, and might answer the purpose equally well.
23	Arthur S. C. Wurtele.....	I consider these time reforms to be time confusions. The matter of one railroad time could be easily settled by our great transcontinental lines setting the example with the co-operation of observatories in the different States.
24	W. A. Sweet.....	Whoever has devised this scheme has given it lots of study and careful thought and no doubt fully covered all the ground well, and without devoting any time to it—only reading the circular—it seems to me carefully and thoroughly planned, and worthy of support.

No. Am. Soc C.E.	NAME.	QUESTION 11.
25	Wm. T. Jennings.....	None.
26	M. G. Howe.....	I have not given attention enough to the subject to be able to suggest a scheme that appears to me to promise better than the one outlined, in Questions 7 and 10. There is no doubt but that reform is needed, and I sincerely hope that the efforts of those who are agitating the subject will be crowned with success.
27	Robert H. Sayre.....	I am decidedly in favor of "time reform," have no particular views to put forth, the scheme suggested on page 28 is simple and sensible. I hope you will urge this and refuse to entertain any other. If other nations refuse to come in to the measure now, let the United States adopt it. There is so much to recommend it, that the world will come to it in a few years.
28	Robert Moore.....	I think that if the railroads and steam lines would generally adopt this system the general public would follow, and that every effort should be made to enlist co-operation in those directions. To this end the scheme should be studiously practical and not too sweeping at first.
29	J. Foster Crowell	
30	John Notman.....	None except as stated.
31	T. J. Potter.....	
32	W. B. Smellie.....	Have no special views on the question. As cosmic time is proposed for days beginning at the time of the passage of the sun over the prime meridian, and as in nautical and astronomical time the day begins with the passage of the sun over the meridian of the observer there would seem to be an advantage in having the days of local time begin at the noon hour. As this has probably been considered and rejected for sufficient reasons by the able members of the committee, I am prepared to cordially agree with their conclusions.
33	Stephen S. Haight.....	
34	Julius W. Adams, Past Pres. Am. Soc. C.E.	None other.
35	F. N. Gisborne.....	No.
36	James H. Harlow.....	
37	A. B. Cox.....	

The most necessary thing to secure a standard time, valuable to people at large, is to have the time accurate and easy of comparison. When people lived far from these meridians, so that the standard time differs from the local time by ten minutes or so, they would use local time, but if the standard time should prove

No. Am. Soc. C.E.	NAME.	QUESTION 11.
		accurate, they would make the necessary allowance in setting their time pieces. I have noticed that where an hour or two during the day is struck on the alarm bells, as it is done in some places, the time pieces are regulated and are kept exact. When in such places the railroad time varies from the local time, the people know that the difference is constant and allow for it when they travel. But I don't think any set of people would submit to have the sun rise and set half an hour before or after he should. They would simply use the standard time to regulate their local time by. Have not given the subject sufficient study to criticise the scheme with intelligence, but it meets my hearty approval. If adopted the habits of all civilized people will soon conform to the change, and and after a few months the wonder will be why they tolerated the present clumsy and outgrown system so long. I have no particular views on the question of time reform not embraced in the questions and replies above given. Attended meeting at the Canadian Institute, Toronto, when the question of standard time was discussed, and agreed with the decision that there should be a "prime meridian" in accordance with the recommendation of Sandford Fleming, C.E., C.M.G. I can see no just reason for altering that decision. The only objection that can possibly be raised to a standard time will arise in identification. People will be slow to abandon local time marks, and while they may become reconciled to a standard, they will never consent to an error, as the proposed hourly meridian would give at intermediate points. Standard time has become a necessity in many of the affairs of life, but to be available, it must be made so to all. By the simple alteration in the construction of a clock, so as to show both times by a single set of hands. I believe its introduction on this continent would be assured. How would, as the enclosed sketch of a clock answer? It appears to me that there are rational obstacles to universal or even continental time, which we cannot overcome, and to
	38 Edwd. S. Philbrick.....	
	39 Moneure Robinson	
	40 Kivas Tully.....	
	41 T. H. Perry.....	
	42 J. M. Putman	

No.
Am. Soc.
C.E.

NAME.

QUESTION 11.

which we must conform. There is a natural division of time on our globe into periods marked by the revolution of the earth. These periods are equal in length and constitute the natural day. The natural meridian of midnight seems to constitute the proper dividing line between two days. It is so natural and easy of comprehension that a person going from London to New York, has but to turn the hand of his watch to move easily and naturally in the groove of the people wherever he may be.

If, however, a universal standard were adopted, he would be always at a loss to know at what time of day a given hour would occur. There would be a continual confusion with people travelling and doing business in different parts of the country.

If it were possible to flatten out the world, or so arrange the distribution of light, or induce people to commence their days' work regardless of the sun, so that all would commence their days' work at the same moment, then a system of universal time would be desirable.

There are certain laws and forces in nature to which we must adapt ourselves, and whoever attempts to disregard them or counteract their influence will have uphill work. Scientists well know that unless friction and the resistance to motion can be overcome, there is no possibility of a perpetual motion. The true promise of science is not to combat the forces of nature, but to discover wherein they lie, and to so adapt our plans to them, as to make them do our work for us, while following along in their well indicated channels.

If four meridians were adopted for North America, the railroad lines operating east and west, would necessarily cross their dividing lines, and I think the change in time would be so great that the confusion would be as great as at present. Two towns only an hour's ride apart would have an hour's difference in time. It seems to me that there will be least confusion by keeping as close as practical to the natural day.

The tendency of modern practice is towards the decimal division of all

43 Charles H. Swan.....

No.
Am Soc.
C.E.

NAME.

QUESTION 11.

weights, measures and coins. This is shown by the rapid spread of the metric system among civilized nations. During the first ninety years of its history it has been legally adopted by thirty different countries including some of the most important nations on the Globe. It is also shown by the fact that the opponents of the metric system usually advise the decimal division of the ancient measures retaining a few of those most in use instead of the adoption of the more perfect decimal metric system.

The decimal or centesimal division of the quadrant has been adopted, but has not yet been extensively used. It is *still in use*, and with the development of decimal methods in other branches of metrology, it will become more and more prominent and will eventually supersede the sexagesimal method.

A reform in the method of defining time looking so far into the future, and contemplating such universal use, as does the scheme of your committee, should embrace the probability that the centesimal measurement of longitude and time will eventually supersede the present methods.

The plan adopted should be based upon elements common to both methods. The change when made, will be made consequently, for all time, and no revision will be required upon the adoption of the centesimal method.

The details of the centesimal method have been ably presented in two papers, upon the division of the circle and the division of the day, read before the American Metrological Society by Mr. Fred. Brooks of the American Society of Civil Engineers. Copies of these papers are hereto appended, marked A and B, and form a part of this communication.

The following suggestions are offered for the consideration of your committee :

I. That, regarding time, the adoption of the centesimal method will merely alter the hour and its parts but not the day or year.

II. That regarding longitude, its adoption will render the *kilometer* available to the traveller by *sea*, and for all geograph-

No.
Am. Soc.
C.E.

NAME.

QUESTION 11.

ical purposes, in place of the nautical or geographical mile.

III. That the 24 meridians of the cosmic day be used temporarily for *standard municipal time* until the adoption of the centesimal meridians.

IV. The 24 meridians of the cosmic day differ in longitude $16\frac{2}{3}$ centesimal grades. The interval between every third meridian is 50 centesimal grades, and every third meridian from the initial point is common to both methods. It is therefore suggested that *standard railroad time* be based upon the eight continental meridians C F I M P S W and Z, which are common to both methods, either exclusively or to the greatest practical extent.

These meridians are well situated for governing continental time, as is shown by the following table and by the diagram of your committee.

V. That in telegraphy the cosmic day be used exclusively. The primitive meridian Z, of the cosmic day is common to both methods.

VI. That the present division of the day into 24 hours of 60 minutes of 60 seconds be retained only until a method dividing the day in conformity with the centesimal method of measuring longitude shall have been adopted.

Table showing Continental Meridians common to the Centesimal and Sexagesimal Methods of Measuring Longitude and Time :

CENTESIMAL METHOD.				SEXAGESIMAL METHOD			Principal Country or City on or near meridian.
Meridians.	Distance from initial Meridian in Kilometers.	Arc in Centesimal Grades.	Time in 40ths of a Day.	Distance from initial Meridian in Statute Miles.	Arc in Degrees.	Time in Hours.	
C	5,000	50	5	3,112	45	3	Japan, Australia.
F	10,000	100	10	6,224	90	6	Central Asia, Calcutta, [Bagdad]
I	15,000	150	15	9,337	135	9	Russia, Mesopotamia, Arabia, Mocha
M	20,000	200	20	12,449	180	12	Greenwich, W. Europe, W. Africa
P	25,000	250	25	15,561	225	15	South America, Brazil, Rio Janerio
S	30,000	300	30	18,673	270	18	New Orleans, North America
W	35,000	350	35	21,785	315	21	Alaska
Z	40,000	400	40	24,898	360	24	Polynesia

No. Am. Soc. C.E.	NAME.	QUESTION 11.
44	Sir Charles Tupper.....	No.
45	James P. Davis.....	_____
46	P. S. Archibald.....	Having no particular views
47	H. E. Stevens.....	I consider the change practically feasible and of great importance, and would have it consummated in accordance with above as soon as possible.
48	B. S. Henning.....	No.
49	J. Milton Titlow.....	_____
50	William A. Norton.....	_____
51	C. A. Young.....	I think it important in the present state of horology that the standard time should not depend upon the work of any one observatory, but should be determined by combining signals from a number widely distributed over the country so as to insure clear weather, and actual star observations every day.
52	Robert A. Shailer.....	No.
53	L. B. Archibald.....	_____
54	F. B. Stearns.....	_____
55	C. S. Davidson.....	_____
56	Edward Maguire.....	_____
57	E. G. Ferris.....	_____
58	Collingwood Schreiber.....	No.
59	Henry Gannett.....	_____
60	James P. Howley.....	I think it would be very advisable, as Mr. Fleming suggests, that some plan should be adopted by which existing time keepers could still be utilized without much alteration. The loss of wealth in condemning all such entirely, would be enormous, and would operate greatly against the acceptance generally of the scheme.
61	E. P. Alexander.....	The answers give my views fully except in reference to division of day into hours, and dispensing with A.M. and P.M. I favor the 1 to 24 plan to be started by R. R. publishing all time tables in that form. At least I favor that in theory, but I am not prepared to say that I would yet venture to try it in practice. I fear that until the engineers and conductors become used to it, which would take some months, and whenever new men began to use it, there would be danger of accidents. It would certainly be necessary to give a good deal of instruction and some practice in it before adopting it fully.
62	W. H. Wood.....	_____
63	F. M. Towar.....	_____
64	Julius J. Duraye.....	_____

No. Am. Soc. C. E.	NAME.	QUESTION 11.
65	Thomas S. Sedgwick.....	I favor sectional time areas for the running of railroads. Lines east of Hudson River to be run at Boston time, those west and east of Alleghany Mountains on Washington time. Those next, west and east of Mississippi River, Indianapolis, thence to Utah Valley, some central time, Cheyenne or Denver, or Austen, Texas, on the Pacific Slope, Sacramento time. The changes to be made at convenient places as suggested on page 18.
66	George M. Dawson.....	In the regulation of time by standard meridians a difficulty suggests itself in the time of rising and setting of the sun, moon and stars. Instead of rising at the same clock time in all places on the same parallel of latitude, the rising and setting would require to be given separately in almanacs, etc., for every locality. Besides the actual change in time due to latitude, an artificial difference due to longitude would be added. Result, complication in a matter closely affecting the routine of ordinary life.
67	T. C. Mendenhall.....	No particular views except as indicated in the previous answers.
68	L. J. LeConte.....	I have none other than embraced in the scheme.
69	Edward C. Pickering.....	
70	H. F. Royce.....	
71	J. S. Sewall.....	Life is short, and it is a big contract. To make it practicable to introduce such system, the changes should be as few and simple as possible. To be consistent, and to completely carry out the system, all the hours everywhere, should be called by the standard meridian letters, but I don't think it possible to make so great a change. If the minutes can be made to correspond everywhere, keeping the hour as nearly as possible to what it has always been, a long step will be taken in the right direction, with such slight actual change as not to confuse anybody.
72	W. B. Hazen, Major Gen	As a minor matter, I would suggest that it would be well to use the name "U.S. standard" or "American time" in preference to "standard S time" or "90°" Greenwich time. The people at large would not understand the significance of the letter S., and prejudices against the system might be awakened by the use of the word Greenwich. The system, however, should be based upon the Greenwich meridian.

No. Am. Soc. C.E.	NAME.	QUESTION 11.
73	J. M. Buchan	
74	George Kennedy.....	I have nothing to add
75	E. D. Ashe.....	
76	Wm. P. Judson.....	The use of letters of the alphabet for the P. M. hours would be impracticable for popular use. To say 30 minutes past X would convey little idea. The use of A.M. and P.M. would be made unnecessary by keeping the same divisions as now, and lettering the hours thus—A.M., 1, 2, 3, 4, 5, 6, etc. P.M. --I, II, III, IV., V, VI., etc.
77	Wilson Crosby.....	No.
78	W. H. Pratt	The above comprehends all that we could say as far as I know. I take the responsibility of answering this, as I can do no better without great delay, if at all. I speak only for myself positively, but so far as I know or can judge from past discussions of the subject, believe that our members will generally concur in what I have stated as my own ideas in regard to it. Earnestly hoping that this great step forward will be taken, and that our country will take the initiative in it.
79	George S. Gatchell	None at present.
80	H. S. Pritchett.....	
81	C. J. Ives	Have not given the matter special attention. But the great inconvenience of so many "times" makes it obvious to my mind that if there were <i>less</i> , it would be much better.
82	Asa Horr, M.D.....	I have only to suggest that the dials of time pieces might be constructed with revolving zones, carrying the letters denoting cosmic hours, that could be set as required for local time at any given meridian, such dials to be numbered from 1 to 24.
83	J. L. Gillespie.....	
84	Wm. P. Anderson	I should like to see the divisions of time and of a circle made more correspondent than at present. Now the divisions in both cases are a mixture of the duodecimal and decimal systems. It would be much more scientific if a pure system—duodecimal preferable—were adopted, but I can see that the practical difficulties in the way of doing this would be almost insurmountable.
85	Rufus Ingalls.....	The subject not having been made a study in this office, I do not desire to offer any extended views on the question of time reform.

No. of
Am. Soc.
C.E.

NAME.

QUESTION II.

- 86 W. E. Jacobs
87 Winslow Upton

- 88 H. A. Howe

- 89 D. R. Taylor
90 J. R. Eastman

- 91 James R. Barber
92 Simon P. Newcomb

- 93 DeVolson Wood

It would help the movement if an almanac were published, giving the times of sunrise, etc., in the standard time of the country at different places. This would be a useful supplement to the time tables issued by the railway companies.

As to the division of the U. S., I think as follows: The division should be by States, so that everybody acquainted with the geography of the U. S. would find no difficulty in understanding the scheme. 6th from Greenwich, the States bordering upon the Mississippi and three lakes (Superior, Michigan and Huron) together with Alabama; 5th, from Greenwich all east of the 6th States; 7th, from Greenwich the double row of States west of the 6th States; 8th, from Greenwich, all States west of the 7th States.

I see no good reason whatever for adopting a standard meridian outside of our own country, or for multiplying standards within its borders, in fact I am utterly opposed to both schemes on the ground that they are not desired by transportation companies or for scientific purposes, and the mass of the people will always use local time. I will add that I have had about fifteen years' experience in preparing and transmitting time signals.

The plan proposed, I believe by the Metrological Society of having four times differing an hour, to be called Atlantic time, Mississippi Valley time, Rocky Mountain time and Pacific time, seems to me to be the most practicable. But Atlantic time should correspond to the meridian of New York, unless Washington is preferred. We then have a familiar standard to begin with. It is a practical question for the railroads whether to use only the one standard time, that of New York or Washington.

Absolute time will differ from local time, except on one meridian, and the greater the difference the more marked it will be, and the more certainly will both be kept. These make the notation

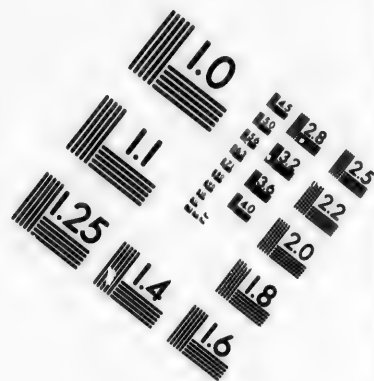
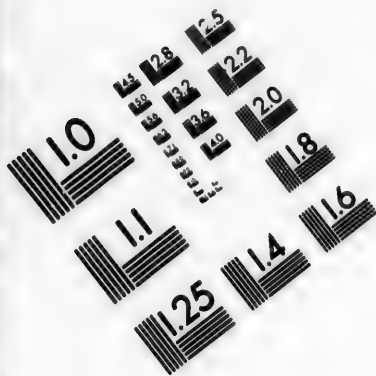
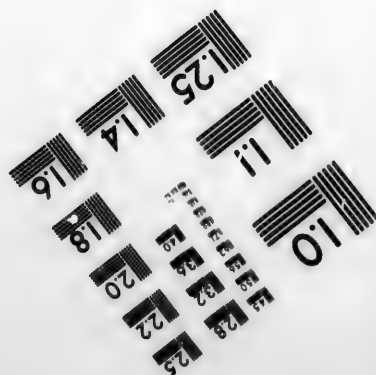
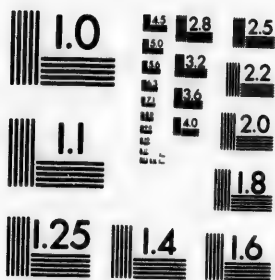


IMAGE EVALUATION TEST TARGET (MT-3)



23 28
32 25
22
20

01

No. Am. Sec. C.E.	NAME.	QUESTION 11.
		of absolute time as simple as possible. For this country only, the meridian of Washinton would commend itself. Next, for the scientific, Greenwich would have the first claim; but for the world at large a meridian in the Pacific Ocean has the strongest claim 180° from Greenwich. Do not call it "Cosmic,"—that would kill the entire scheme. Call it "Clock Time" or "R. R. Time" and present time "Sun Time." Absolute time will not take the place of local time, the former will be used generally for business, the latter for the convenience of a community or for the town. For the purpose of regulating local time conveniently, I think the principle proposed by Mr. Sandford Fleming at fig 7, page 29 of his pamphlet of 1878 is all that can be desired. None except those given in my letter to Mr. Allan I fear that having standards of time, differing by intervals of one hour, would still give great trouble, especially to railroads, as they would be compelled to state what standard was to be used, and everyone would be uncertain which standard their watch was set by when travelling. At places half way between the standard time meridians, there would be great confusion from ignorance as to exactly where the change of the one hour was made, or knowing it, it would be often forgotten. I would propose that "Cosmic" or "Cosmopolitan Time" should be used, the time zero to coincide with the initial or prime meridian and thus the time pieces around the whole world could be always indicating the same hour and minute. This would be much more convenient for railroads, telegraphs, &c., than any other system, and seems to be perfect so far, but for the local civil day, it would be impossible to make one day end and another begin during the busy hours of the day, but the difficulty would be gotten over by beginning the local day at each place as now, 12 hours before the sun passes the meridian. This would, of course, bring odd hours
94	William F. Ellis	
95	Alex. Murray	
96	Edwin A. Hill	
97	C. D. Ward	

No. Am. Soc. C.E.	NAME.	QUESTION 11.
-------------------------	-------	--------------

98 M. C. Meigs, Brg.-Gen. U. S. A.

for the beginning of the day, as, for instance, here in New York the day would begin at 5 o'clock as indicated by the time piece, though it would be midnight all the same, and noon would be about 17 o'clock,

This plan would render unnecessary the designating of 24 standards one hour apart.

This plan, of course, has its objections, but is, I think, simple, and would soon become familiar, and would render unnecessary any resort to the use of letters for numbering which would be *very* troublesome indeed.

In all great reforms success depends greatly upon making the steps convenient. If you derange the habits of a people too much they will have none of it. We travel greatly, but more millions stay at home than go abroad. The house wife keeps the time for the hours of meals and retiring. We men and boys only follow. No clocks are accurate. The best do not keep universal time, but have a ruling + or -. Sometimes both + and - are invariable. It requires correct observers by good instruments of the Heavens to know what hour for the clock is wrong. It is always wrong.

While it would be very nice to have a cosmopolitan time, I don't think it would benefit the public as much as a purely standard time for the American continent would. If we take the first standard meridian for America through New York or Philadelphia, we will have local and standard time less than one hour apart, all over the Continent, and everybody will find that reasonable and plain. But if we count time from the Behring Straits meridian, we will find it to be a graceless and severe task to make the average man believe that it is easier and better to call, for instance, his 12 o'clock noon 19 o'clock or 7 o'clock, or—[sic].

If the hours of the day of commercial time are numbered consecutively, and the hours of the day of local time as at present, I think it would tend to make the time so distinct that there would be but few mistakes. Time pieces with dials to register the 24

99 Julius Pehlman

100 J. C. Wood

No. Am. Soc. C E.	NAME.	QUESTION 11.
101	Lewis Bass.....	hours would soon be introduced, and persons would learn to designate the time quoted with some distinguishing affix. I must confess to having "views" on this subject. I hope to present them at the Montreal meeting of the American Society for the Advancement of Science, when the committee on standard time, of which I am a member, meets. We should not attempt to secure what is impracticable. To abolish local time is not, in my opinion, even ideally desirable. If we could have a standard "traveller's time," I think it would be a good thing. Greenwich time for that purpose seems to me just what is wanted. So far as my observation goes, even the travelling public are not very anxious about it. Still I think they would acknowledge the great benefit if the system could be inaugurated.
102	Melville Dui.....	Considerable study of the question leads me to the identical conclusions except as to numbering hours. The report errs on page 32. 11 does not show without explanation whether it is cosmic time, or 11 a.m. or 11 p.m. old system. New time must come in gradually, and to recommend an entry, 11 o'clock would be fatal to its success. It may mean as above either of three things. If 1 to 12 are used at all they must be marked as new time by some symbol. To this and to Nos. 13 to 24 is the objection if space and characters taken—a serious matter in determining a universal system. To add p.m., a.m., N.T., &c., to all cablegrams and telegrams won't do. Plan 2, 2nd pt., to number hours from noon to midnight by cosmic letters has only to be extended to forenoon to meet all objections, mechanical and popular, viz.: 1. It is <i>shortest possible</i>, one character for each hour. 2. It carries its own explanation and cannot be confused with any other time. <i>It is clearest.</i> 3. It is itself the cosmic universal time, saving all translation and possibility of error. <i>It is most universal.</i> 4. Being only cosmic time it may be

No. Am. Soc C.E.	NAME.	QUESTION 11.
------------------------	-------	--------------

given to the public in the simplest and briefest explanation of all plans proposed, and the great public must have a very brief and simple description of the new plan, or they will reject it. It is *easiest explained*.

5. It is applied to present clocks and watches, *easiest and cheapest*. Single symbols lettered on old dials (with a pen) putting the proper noon letter for each locality under 12 would do it all. In changing localities the traveller would simply hold his watch with the proper letter at top, and the eye would recognize instantly the time relation to noon *e.g.*, my dial has now R at 12. I may go to New Orleans where noon is S., and I take my watch out and hold it with 1 at top and S under it, and recognize T. U., &c. as equivalent to old 1 and 2 p.m., though my old dial has 2 and 3 above them. The habit of reading position or dials is stronger than the figures.

A number of cheap and practical devices for marking the noon letters occur to me, when it shifts from old 12. An underscore circle of red or other mark on dial. A bit pasted on dial or crystal, an index attached and moveable, or more perfect (and costly) a plan of setting works, so in the case in 12 varying portions, so the ring and stem could be always over the noon letters.

I find this plan meets all the difficulties which arise for all the others, and hope it may be adopted.

Each locality would learn its forenoon letters, as easily as the report shows, it would learn its p.m. letters as equivalent to old 9, 10, &c.

This method has simplicity, economy, accuracy and practicability, all in a higher degree than either 1-24 or 1-12 and cosmic p.m. letters.

I sincerely hope the effort will be for the adoption of the plan above. If I am wrong in any of my conclusions, I should be grateful for correction, as I wish to print the scheme in our bulletin.

To express my views in brief: I favor the use of local mean time for all ordin-

No. Am. Soc C.E.	NAME.	QUESTION 11.
		any business of life, everywhere as most <i>natural</i> and <i>convenient</i> (a large city will, of course, use the same central time, a deviation from it of 1m will, therefore be rare) all telegraph companies and railroad corporations to use Greenwich civil mean time (counted from midnight 0 to midnight, 24 hours) for purposes of ADMINISTRATION, thus all trains to be run by, and all telegraph messages to any place, or country, to be used by Greenwich time. But all time tables, arrival and departure of trains at every place to be started in <i>local</i> mean time <i>invariably</i>. The showing of Greenwich time at depots or offices to be marked Greenwich time, otherwise the clocks are supposed, and should give local time, which latter only is of interest to the public at large. The introduction of this scheme will not interfere with the habits of the people, and accomplish all that is necessary for the regulation of intercourse and safety of travel.
104	David H. Jerome	
105	W. T. Sampson	I think the plan of dividing the continent into time zones of one hour each is objectionable, because I think it would be found to increase the difficulties which now exist in railway travelling. The main lines of R. R. running east and west have already divided the country into time zones in the most practicable way. For instance the Boston and Albany R. R. run on Boston time, and the N. Y. C. on New York time, the Lake Shore & Michigan Central on Columbus time. The officers of each road always use the same time, which is a consideration of vital importance. A division into time zones of one hour each, would in some cases require a train to change its time <i>en route</i>.
106	Ormond Stone	I am in favor of a number of standards, each differing by one hour. As to what meridian shall be initial I do not care at the present time to commit myself.
107	H. L. S. Smith	
108	Wm. Brydone-Jack	
109	John B. Hamilton	
110	Henry F. McLeod	No. I take much interest in keeping correct local time, and generally establish an astronomical meridian wherever I may be, as I have done here for the purpose of

No. Am. Soc. C.E.	NAME.	QUESTION 11.
-------------------------	-------	--------------

111 Jacob M. Clark

getting the Sun's meridian transit with convenience.

The greatest error in clocks as compared with local time will only be half an hour slow or fast, as the place is east or west, of the nearest standard meridian; but the clocks in two adjoining places, regulated by different adjoining standards will show a difference of one hour. This cannot be avoided; and the advantage of having the exact hour difference, with synchronal minutes and seconds, will probably more than compensate for the inconvenience.

Tune reform is so intimately connected with general metrology that I think no radical change should be made except those which are in harmony with a general system, as scientifically perfect as possible.

The first step is a rational metrical division of the circle, which we do not at present possess, although there are rational features both in the general division and that for time.

Then the division for time should be identical with that for general purposes.

Also longitude should reckon consecutively around the circle, the same as time; the zero upon the nether cosmic meridian. It would then harmonize with right ascension and greatly simplify all astronomical and chronological work. Such a change would be specially acceptable by navigators.

My dissent from some of the positions taken as I understand the documents by no means implies doubt of the importance of the main objects sought or the great value of the suggestions made. But to me the subject appears so connected with metrology that I believe its best solution will grow out of the general adjustment as a matter of course, or if found in advance will be in that direction. A fundamental objection to interference with local time is that it tends to derange the order under which natural phenomena appeal to the intellect. Experience of nature is the very mother earth and habitation of science—day and night—the processional cycle—are not

No.
Am Sec
C.E.

NAME.

QUESTION 11.

more inevitable than that human activity follows the sun. And the ancient theorem sometimes obscured of a cosmos in which the known and unknown are alike related to infinite intelligence under all pervading mathematical laws reveals no way of supplanting general by special factors, without as it were rendering the dues of science to Caesar. The natural order is the scientific one—and the advance of apparent time from east to west is, even to the rudest of men one of the most striking and thought-awakening things in nature—and where the rudiments of popular education exist, its rate in distance and longitude is likely to be fairly understood as a thing of precept in the school and folk lore at home, and I am convinced that for all main purposes the people will adhere to local time the more persistently as they advance in knowledge. Domestic clocks will be set by the sun according to the almanac. Surveyors, navigators and explorers must find azimuth and position in terms of local time—and observatories must be equipped and observations conducted strictly according to the local meridian. Communities will settle standards of local reference better and more acceptably without civil intervention than with it, and of the thousand or more millions upon earth the comparatively few who need refer specifically to cosmic time are mainly of those most competent to make the calculation for themselves. The difference between cosmic and local time can be made apparent everywhere by the simplest means. A concise table for instance, a diagonal line upon co-ordinately ruled paper, a dial with a revolving rim and in various ways. The division of the day into 24 consecutively numbered hours which I should insist upon is rather small for marking time dials especially watches. I would continue the numbers upon an inner circle and so of the cosmic symbols on the revolving rim. The reckoning commencing at midnight the outer row of each would

No.
Am. Soc.
C.E.

NAME.

QUESTION 11.

designate forenoon hours. New dials at trifling cost would save all existing machinery, except where the second hand might become important in case of decimal sub-division, and even then but one member of the train would have to be changed, and so time pieces could show both local and cosmic time by simply adjusting the rim. And it is clear to me, that by adopting some such device, transportation and telegraph managers could conduct their affairs with perfect safety by convention either according to local or cosmic time, as they might please to advertise, and it might be doubtful whether Governments need go further in this particular beyond permissive legislation than to settle upon a prime meridian according to the broadest requirements of science, to aid the people through signal service and otherwise in fully understanding the subject, and to a fair extent and at the proper juncture in re-forming their dials. And for reference longitudes being known, it is as easy to compare local time with that of any one standard meridian as with that of another; and vastly simpler to have only one, than a greater number however symmetrically disposed. I would by all means have but one standard, the cosmic, for all purposes of reference. The statement I ventured that time should be reckoned according to a metrical division of the circle, and that longitude should be marked around the circle to correspond, and so harmonise with right ascension was made without being clear at the time what that metrical division is. I think, however, it can be understood by seeking the greatest common divisor of all the commensurable arcs which can be obtained by pure geometry without repeating a method. Such repetition is of course a blunder which effectually "begs the question" by introducing a special factor out of its place. Without resorting to bisection of chords (the only general means of subdividing arcs geometrically) we ob-

No. Am Sec. C.E.	NAME.	QUESTION 11.
------------------------	-------	--------------

tain nine commensurable ares. One of these the octant, has its tangent equal to radius, and is at the same time the sum of two incommensurable arcs whose tangents are commensurable with radius. Bisect it, and we exhaust the methods with a result of ten commensurable arcs, viz., the $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, $\frac{1}{6}$, $\frac{1}{8}$, 1-10, 1-12, 1-15 and 1-16 of the circumference and their greatest common divisor is 1-240. Now if we select the commensurable quadric ares, or those which have a trigonometrical co-ordinate commensurable with radius namely $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$ and 1-12 their greatest common divisor is 1-24. This fixes the grand divisions at 24 for all the requirements of trigonometry, and indicates decimal subdivision by the main result as well as by the number of factors, and this accords strictly with an indestructible law of the mind, whereby men arrange categories in simple groups and divide into simple fractions for simple off-hand purposes, but for extended enumeration or indefinite subdivision invariably proceed, under the powers of ten—and the 1-240 by its outer and inner polygons fixes the p ratio correct to the fourth decimal. For these reasons I regard the 1-24 as the metrical unit of circular measure, the tenth of this the metrical degree, and decimal subdivision, both for time and arcs the metrical method. One of the ways by which a metrical system might grow out of this arrangement would be this, the metrical degree would span upon the earth about 100 miles, and if we take Callets suggestion made 100 years ago, of the axes of the earth—a straight line—for a base, it contains 500,500,000 English inches very closely. Increase this inch by its 1-1,000 part, as has been proposed, and it becomes a metrical inch and 25 such inches a metrical cubit 1-10,000,000 part of the semi axis and a pendulum at the equator beating,

4,000	times an hour would measure	31,692 metrical
5,000	" " " "	20,237 inches
10,000	" " " "	5,102 "

(very nearly) 5 digits=5 inches=the

No.
Am. Soc
C.E.

NAME.

QUESTION 11.

natural hand breadth including width of thumb: $6\frac{1}{2}$ inches—the natural span or extended hand.

25 inches—the cubit—the natural arm's length, also the legionary step.

10 inches—the natural foot—and there might result:

For the arts: inch (decimally subdivided):

10 inches—1 foot.

10 feet—1 reed (builders, shipwrights), etc.

10 reeds—40 cubits (chain of 100 feet—83.42 English feet.

For rural purposes (convertible),

Foot cubit reed and chain as above.

40 inches—1 yard or ell (cloth, etc.)

50 inches—2 cubits—1 staff (wood etc.) (16 soll 1 cubits—1 cord.)

20 feet—8 cubits—1 rod.

250 feet

100 cubits

12½ rods

2½ chains

10,000 square cubits } 1 acre—43,489.6-10 English

62,500 square feet } square feet.

Existing acres reduce to metrical by adding

1-6 of 1 per cent.

Engineering and Geodesy.

(Cubit decimally sub-divided):

10 cubits—1 pole (base bar).

100 cubits—1 acre (a convenient length for steel tape chain).

1,000 cubits—1 stand (tally or halt).

10,000,000 cubits—polar radius.

Levelling by cubits—Solid cubit, the measure of engineering work—

Geographical, road and sea measure.

0.2624 cubits } —1 span.
656-100 inches }

10 spans—1 fathom. } Knot measure, glass
10 fathoms—1 road chain. } 1/100 of an hour. Mast
the height
which the horizon
appears 10 miles away.

100 fathoms—1 stadium.

125 fathoms—1 furlong (cable length.)

8 furlongs 1 mile 41 rods.

10 stadia } 5,472 } 1/2 of a furlong—41 cubits.

328 rods } English } 1-16 of a stadium—

2,624 cubits } feet. } 41 feet.

6,560 feet

10 miles—the offing.

100 miles—1 degree (mean terrestrial upon radius

of volume).

240 degrees—the circle.

SOUNDINGS IN CUBITS.

The office of geographical measure to which the civil mile really belongs, is

No.
Am. Soc.
C. E.

NAME.

QUESTION 11.

specifically distinct; and it must in some way involve the p factor which is out of place in lineal, square or solid measure. By the above scheme, however, this factor is adjusted out of sight for general purposes in the stadium and furlong—and excepting the mean effect of ellipticity radius being 10, 100, 1000 cubits, and so on, the span and other decimals of the mile are lengths of the metrical degree. For popular comparison the French kilometre is 6.10 of metrical mile and so on. For explorations itinerary odometre work, and the like, the metrical mile will be found incomparably the best.

So long as mathematicians chose to retain two divisions of the circle geographical measure ought to conform to that which is logically the best. The reducing factor is the same either way by inversion.

As to measure of weight and capacity I will only suggest that the avoirdupois pound of water, measuring 27,562 metrical cubic inches, contains not far from 10,000 drops, and the pint contains 28.789 such inches; and I think that by fairly disposing factors a metrical system of simple design might be reached expressed in tolerably familiar terms.

THE PRIME MERIDIAN.

To insure speedy and permanent adoption it might be well to select the Cosmic meridian on such principles as would attract the spontaneous and constant notice of scientific men the world over, from other high considerations along with those connected with time and longitude. It need not intersect any observatory, provided its longitude be known.

Maury is accredited with having indicated a zero meridian some distance east of Greenwich. Its nether to avoid inhabited parts, and so obviate the difficulty complained of as to dates, I cannot believe so eminent an authority overlooked the advantages of the longest accessible arc, for connected observations for the higher aims of geodesy and meteorology, the figures, dimensions and

No.
Am. Soc.
C.E.

NAME.

QUESTION 11.

density of the earth, magnetism and the law of storms. Those who have not given special attention to the subject can understand clearly the numerous and trying difficulties which beset the experiment of assembling scattered arcs however ample and perfect the data, by reading some lectures by Prof. Sanfield Merriman, published in Van Nostrand's Magazine, vol. 22, p. p. 53, 115 and 233.

The longest land arc is in about 25° east longitude, from near North Cape to the southern sweep of Africa. Through Europe its position is unexceptionable, but south of the Mediterranean its stretch of 4,000 miles is largely in waste and untenable regions. Cronstadt and St. Petersburg are nearer the mark. But, accrediting Stanley's latest discoveries, the meridian of either place runs for a long distance lengthwise upon an unexplored divide, for 600 miles more, lengthwise through a system of inland seas as yet imperfectly known, and for another 600, the best, inconveniently to one side of the future main thoroughfare, the Valley of the Nile. Probably there is no better line after all than of the Pyramid. It is 100 degrees, present division in amplitude. For 1,600 miles, the northern limb is through the heart of a populous and progressive empire of vast resources whose collaborateurs in science are perhaps second to none. The southern limb passes mainly between the great interior lakes, and in fair proximity to the points for primary triangulation. It ascends along the Nile for 2,000 miles to the equator, where it attains a mean altitude of some 4,500 feet, which it maintains for 1,200 miles among the head sources of the Nile and the Livingstone or Congo and the Zambesi, crossing the divides at right angles, respectively in 10° and 12° south latitude, and continues through the Transvaal and the Zulu country to Port Natal in 30° south. Through the central plateau it traverses the regions already explored by Livingstone, Stanley and others, in kingdoms which, though

No.
Am. Soc.
C. E.

NAME.

QUESTION 11.

rude, are in part friendly and inclined towards civilization.

The whole extent of 6,900 miles is, with proper enterprise, rangeable, except across the Mediterranean and Black Seas, and affords a greater number of eligible positions for connected observations than can elsewhere be found. It is symmetrically situated with respect to the great Indian arc. Its nether traverses Alaska for some 700 miles and nearly or quite strikes Otaheite. This may prove an advantage in respect of supplementing the main arc by pendulum observations.

Those of us who have advocated what is here termed the cubit as a metre, have found it somewhat difficult to connect it logically with geographical measure in a sufficiently simple way.

This difficulty is removed in a measure by the introduction of hour meridians. And it need not disturb the bearing of facts that some have proposed the same metre, as well as the Pyramid as a reference for longitude, partly on esoterical grounds.

If we adopt Callet's suggestion, the most sensible one ever made, we have but to choose between the cubit of 25 and the unstridable staff of 50 inches. And if we entertain in its full scope, Maury's grand idea of a meridian arc, we can scarcely avoid the astonishing proportions of the oldest monument on earth.

And it would seem that no pure heirlooms of a pre-historic metrical system, if such there was, have survived the dispersion, except the decimal factor (some claim the inch—they might include the Guz of Arabia) the hours—emphatically the four and twenty-elders of astronomy, and the older twelve, the regal glories of her amazing zone. The rest saunters strongly of the sarcasm of the seers upon Babylon—convolution—a repeat—without which no man may buy or sell.

No. Am. Soc C.E.	NAME.	QUESTION 11.
112	Geo. C. Wilkins	I am glad that the American Society of Civil Engineers have taken the initiative in this most important movement.
113	H. P. Dwight	Though it makes no difference and does not affect in any way your daily time suggestions, I hope the days in the month may be better arranged. The odd months say having 31, the even 30—adding one to one of the 30 day months for leap year. February is a nuisance now. January, March, May, July, September, November, 31 days; February, April, June, August, October, December, 30 days
114	William F. Bradbury	
115	S. L. Werden	The only feature that is apparent to me is that in the lettering of 12 out of the 24 hours, the danger of collision or accidents either by rail or water is less, and the chances of serious accidents resulting too frequently therefrom reduced.
116	J. W. Pearl	With affirmation to questions 5 and 6 division of day into hours should have form A; as with form B, a time piece numbered for one meridian would not be adapted to another meridian.
117	M. Giddings	None, save that if such a system as the one proposed were adopted, it would seem desirable that for a series of years at least all the principal time signal stations should be maintained in telegraphic connection with all the trustworthy, permanent astronomical observations, so as to bring up to the highest attainable point of accuracy, the knowledge of longitude differences and consequent differences in local time.
118	R. R. Call	
119	J. W. Mallet	
120	Fred T. Newberry	The importance of the subject herein set forth requires no words of introduction; all that has been said and written thereon has not fathomed its depths, but in that direction to look for relief from the perplexities into which we are rapidly drifting is an exceedingly difficult matter.
		The railroads which are one of the greatest civilizing powers of the age in which we live are the greatest disturbing cause, and it is to this point we now particularly direct our attention in looking round for a remedy. The first question which arises is, shall we seek

No. Am Soc. C.E.	NAME.	QUESTION 11.
		a remedy by readjusting civil time? If we examine this matter closely, we will find that any remedy which may be obtained from this source will only be partial, and will inevitably be attended with more or less confusion. In an island such as Great Britain, this may be accomplished without much inconvenience, but in a great country like the Continents of North and South America, this is impossible. On the other hand it must be conceded that civil time, on account of its universal prevalence, and the hold which it has upon the literature, manners and customs of the people (besides the millions of dollars invested in it), is clearly beyond the power of the greatest power in the land to alter. The question then to be considered is, if civil time cannot be amended or altered to give the necessary relief in the operating of lines of railroads, it becomes imperative that railroads should have a time of their own. This time we shall call standard time, to distinguish it from civil time, and proceed to consider what this standard time shall be like, etc. 1st. It will co-exist with civil time, therefore it must be altogether unlike it, it must register one complete day in continuous order, thus avoiding a.m. and p.m. 2nd. It should have neither hours nor minutes known as such, and be subdivided as to record the smallest (used or to be used) intervals of time. 3rd. It should have but one meridian or zero, upon this meridian must be a first-class astronomical observatory, so situated as to be readily placed in telegraphic connection with all parts of the United States. 4th. It should be expressed in figures altogether different to the manner of written civil time, and also follow the decimal system of notation, so that the aggregating of any number of intervals may be readily obtained in terms of an entire day or any number of days. 5th and lastly. This system should be capable of indefinite extension over the whole of the continent.

No.
Am Soc.
C.E.

NAME,

QUESTION 11.

Having thus outlined the wants of the railroad service in connection with the expedition of its trains, we now proceed with our solution of the problem.

1st. Divide the day from midnight to midnight into ten parts—midnight being zero of the new day and the completed ten portions of the proceeding day, a.m. and p.m. will thus be effectually set aside. The major divisions of the day will be entirely different from the major divisions of civil time, so that the one can never in appearance be mistaken for the other.

2nd. It is proposed to call the intervals of time recorded by our standard *Ex Die*, meaning "out of a day," being written and spoken simply as *Ex.*, thus 1 *Ex* or 1.35 *Ex* or 2.545 *x* or in full, Jan. 16th 5.375 *Ex Die*. The whole numbers will have a value in civil time of 2 hours and 24 minutes, the first decimal 14 minutes 24 seconds; the second decimal 1 minute 26 4-10 seconds; the third decimal 8 64-100 seconds, which we think will be found a small enough subdivision for all practical purposes.

3rd We propose the meridian of the observatory at Washington as the zero of standard time; in its favor we agree that it is an honor we concede to the capital of our nation. It being also the headquarters of the signal service, whose officers would be, *ex-officio*, the executive officers of the standard time signalling corps. Having regard also to the fact that the longitude of all important cities and places of the United States is already published and known in reference to the meridian at Washington; also that the facilities for telegraphic connection between Washington and all parts of the United States are second to none in the country.

4th. The notation proposed for this service is entirely different from that of Civil Time and is expressed wholly in decimals; the major division of the day being in tenths and the minor divisions in continued series of decimals, for instance, 44 minutes past nine o'clock a.m. at Washington would be 4.055 *Ex. Die*, 44 minutes past 9 o'clock P.M. at Washington would be 9.055 *Ex. Die*

No.
Am. Soc.
C. E.

NAME.

QUESTION 11.

It is apparent that any aggregations of small intervals can be readily expressed in days and parts thereof. It will also be found much more convenient in communicating by telegraph with employees, to send statements of time in this notation, and also much more concise, and with much less liability to error than the same expressed in terms of Civil Time.

5th. It is evident that no possible extension of the railroad system could possibly outgrow the limits of our proposed system, when once the prejudice of our foreign neighbors was overcome to receiving time from Washington all would be plain and straightforward as in our own States.

One other advantage is, that the railroad centres receiving time direct from Washington each day, and the longitude of the railroad depot being known, the change into local time is at once obtained, so that the inhabitants of that locality are at once delivered from the caprices of dealers in watches, etc., who generally consider that to stand well with the community they should have a time of their own, which of course no rival establishment would think it wise, prudent or politic to follow.

All time tables for the government of employees would be made out in terms of *Standard Time*, and they would be provided with timepieces corresponding thereto.

Clocks upon which the electric current from Washington will act and regulate automatically will be maintained at the principal depots.

Time tables for the public will all be made out in local time corresponding to the locality of all important cities and stations, railroad crossings, ferry landings, etc.

By means of an apparatus (design submitted) the conversion of standard time into local civil time is readily furnished, so as to avoid all possible errors in calculation.

In conclusion, it becomes manifest that standard time thus outlined, being accepted and generally adopted, that at any instant, say 4.36 Ex. Die., the actual posi-

No. Am. Soc. C. E.	NAME.	QUESTION 11.
		tion of any train running according to the schedule, would become known all over the United States. Operating time tables would be readily exchanged and fully understood, and the movements of trains fixed with good judgment, would be carried out with certainty and confidence by those in charge, though the light of day be obscured by fog, or in the blackness of stormy night.
121	D. Hudson Shedaker	No Sir.
122	Edward Gilpin.....	
123	John Twigg.....	I have explained in my replies to the foregoing queries and I think their substance is sufficient, and I have to express the wish that objects sought for will be obtained.
124	F. P. Dunnington.....	In reading an account of any occurrence in private life, when there is little difference in latitude (<i>sic?</i> longitude) we can correctly assume the advance of day by the (present) local time when given to us, but if the time were quoted in the proposed standard we might need to consult a map to determine whether the occurrence was before or after sunset, sometimes a very important difference, while now we need only call to mind the time of the year to settle such doubt.
125	Francis H. Smith.....	I have nothing to add at present.
126	Clarence J. Blake.....	
127	Wm. M. Thornton.....	It is to be regretted that it is not possible to introduce concurrently with this reform the "metric" or centesimal division of the quadrant, giving 400 degrees of longitude, dividing the day into 4 periods of 10 hours each, using 40 standard meridians and having a maximum deviation of local from conventional time of only 1/80th of a day, in our present units, 18 minutes. The modification in pure and applied mathematics will, in time, surely come, but it is perhaps too soon.
128	Albert Chapman Savage.....	I would only say with reference to my reply to question 6 that the standards <i>N</i> and <i>T</i> seem to divide the territory better than those mentioned, <i>R</i> or Atlantic time would thus control all territory east of the Mississippi River; and <i>T</i> or mountain time all west of it in the United States: British Columbia or Alaska time would be controlled by standard <i>W</i> : Trains run now to this point from St.

No. Am Sec C E	NAME.	QUESTION 11.
		Louis on Jefferson City, Mo., time, west of here, on San Francisco time, 2 hours earlier.
129	M. C. Fernald.....	Instead of using the letters A, B, C, etc. why not use the numbers 1, 2, 3, etc., since the letters are but arbitrary symbols, and all computations as between standards must be based upon the numerical relations of these symbols (or letters) in the series? Instead of saying meridian R say meridian 17, instead of standard R, standard 17. The corrections for hours become very simple.
130	John H. Blake.....	
131	E. Fontaine.....	I might possibly give some suggestions if I were employed as a professor of physical geography in some institution which would give any weight to my opinions; but having no talent for getting office or acquiring notoriety, and forced into retirement by either the greater merit, or the greater shrewdness and activity of others, and engaged as I am in solitary studies of subjects somewhat in advance of the scientific progress of the age, and which have employed me for years, I have not <i>the time</i> to make the important subject of measuring time properly—a special work—nor the money to enable me to attend the meetings of the associations of science, and especially of the Civil Engineers, which I greatly regret. I was compelled to donate a volume of some of my <i>half explained, but little understood</i> “contributions to the science of Hydraulic engineering” to the U.S. Government, not having the money to publish it <i>pro bono publico</i>. It was published by an Act of the 46th Congress in 1879.
132	Fred Brooks.....	The Committee's scheme reduced to its lowest terms is to use Greenwich time all over the world, and is to my mind very commendable, (for fear of offending prejudices, however, some advocates of the scheme seem desirous to disguise its character.) For railroad, telegraphic and some other purposes, the advantages of the scheme is sufficiently evident. But for some other purposes local time is required; for instance the almanacs give the local time of the sun's rising and setting the same over a large territory, whereas different places would have their times

No
Ann. Soc
C.F.

NAME.

QUESTION 11.

of sunrise and sunset different if stated always in Greenwich time. Reference to daylight and darkness is absolutely necessary for a great many human affairs of much importance. The essence of the Committee's Scheme is to state the Greenwich time in two parts, the first of which is substantially longitude west of Greenwich, the second local time at the meridian of that longitude thus combining in the Greenwich time statement, a local time also. For instance a time of six hours + 5h 30m is half past 5 o'clock at the meridian six hours from Greenwich. Greenwich time at that instant being 11h 30m, (I don't think there is any real advantage in putting the letter S in place of the figure six. On the contrary I think it a disadvantage)

The Committee remarking that most people now use, not the exact local time of the place they are in, but the local time of some other place, conclude that 24 local times would be sufficient for most of the wants of the whole world and would be a great simplification. In this conclusion I concur. The number 24 of course is preferred because of the universally established practice of dividing the day into 24 parts. Were it not for that, a larger number of local times would appear to me preferable, I think the greatest real objection to the Committee's scheme consists in the discrepancy which it would introduce between clock time and apparent solar time. The sun is now on the meridian at different seasons of the year, a quarter an hour before and a quarter of an hour after clock noon. By the adoption of the Committee's scheme the discrepancy would be increased in some places to three quarters of any hour, which I think would be found a perceptible inconvenience, and might conceivably justify the introduction of an intermediate local meridian for reckoning time. For instance, at a meridian $6\frac{1}{2}$ hours from Greenwich, a local time of $2\frac{1}{2}$ hours might be stated so as to be understood elsewhere as $6\frac{1}{2}$ h + $2\frac{1}{2}$ h which would be $8\frac{1}{2}$ hours of Greenwich time. The

No.
Am. Soc.
C.E.

NAME.

QUESTION 11.

establishing of a system of *lettering* for standard meridians would not admit of such a modification, if such should prove to be necessary; whereas a system of *numbering* would lend itself readily to modification.

One change which the future may bring about is a decimalization of the reckoning of time and longitude. The division of the day into 24 hours with sexagesimal subdivision, and the division of the quadrant into 90 degrees with sexagesimal subdivision (though relics of ancient ignorance) have to recommend them the same argument that the Committee offer for their standard time scheme, viz., that of uniformity nearly the whole world over. But to secure this same great benefit of uniformity in regard to the much more important matters of coinage and ordinary weights and measures, most civilized nations have made strenuous efforts resulting in the general establishment of decimal subdivision. The English speaking nations have thus far shown comparative indifference to this grand movement. Here in Mexico decimal coinage and the metric system of weights and measures have been introduced. The Committee's scheme for uniform international time is therefore particularly pleasing to me as indicating an increased appreciation in the United States and Canada of the necessity of international harmony. But with other units of measure uniformly decimal, I believe that, ultimately, the measurement of time and arc, though already nearly uniform, will be changed to a decimal system and one in which the two will harmonize with each other, better than they now do. In planning for the future I think the Committee ought to consider all such possibilities, though it may not be their duty to report upon that branch of the time question. I have accordingly mailed in a separate circular to John Bogart for the Committee, two little papers, "*Sur la division decimale de l'angle et du temps par M. A. D'Abbadie*" and "*Sur le choix de l'unité angulaire*"

No.
Am. Soc
C.E.

NAME.

QUESTION 11.

par M. J. Houel." After the Committee have examined them, if they have no other use for them they might be turned into the library of the A.S.C.E.

My own opinions with regard to this matter were stated in two papers printed by the American Metrological Society to which Prof. Egleson of your Committee will probably give access. They were read before that society in May 1878 and December 1878. One of them was included also in an article in Van Nostrand's Magazine for June 1878 entitled "Decimal and other arithmetical notations." I think that a movement for altering angular and time measures should be initiated by astronomers rather than by Engineers who are less concerned therewith. What it behooves the Committee to notice (as I think) is the following point. If the meridian passing through particular places upon the earth's surface be arbitrarily denoted by particular *letters* of the alphabet and established as the places of standard time, then so much more obstruction to be uprooted will be placed in the way of reforming the reckoning of time and longitude, whereas if standard meridians be designated *numerically* by their longitude from Greenwich, any alteration introduced in the mode of reckoning longitude and time would naturally carry with it the corresponding alteration in the standard reference meridian, without much increase in the mental effort required. Suppose for instance, that the quadrant should be decimally divided, let us for convenience in speaking, call one tenth of the quadrant a dekagrade of arc. Suppose also that the day should be correspondingly divided into 40 parts each of which, for convenience in speaking, we may call a dekagrade of time. Then if T be a standard meridian here in Central Mexico, and people should be in the habit of designating a time as T, 2 hours or other time of the clock, to introduce the change I suggest, would necessitate two things: one the introduction of the dekagrade of time as the

No.
Am. Soc.
C.E.

NAME.

QUESTION 11.

unit instead of the present clock hours, and the other the use instead of T of some other designation of the meridian of reference, as meridian T would cease to be at a convenient distance from the other reference meridians. If on the other hand the standard meridian be indicated as 7 hours from Greenwich and time in Central Mexico as 7 h + 2 h or other time of the clock, then to introduce the change I suggest would be substantially *one* operation instead of the two hours or 2-24 of a day of local time we would have as before to substitute 3,333-40ths or 3,333 dekagrades of time. Instead of the 7 hours of longitude or 7-24 of a circumference, we should have by an operation of exactly the same nature, to substitute 11.667-40 of a circumference or 11.667 dekagrades of arc. But instead of actually using 11,667 dekagrades + 3,333 dekagrades to denote time, we should of course use 12 dekagrades, + 3 dekagrades or speak of 3 dekagrades time at the meridian of 12 dekagrades arc, thus substituting the the meridians of 12 dekagrades as a standard of reference in the place of that of 7 hours as the natural and obvious outcome of the change in the unit of measurement.

I happen to think that if it were the established custom to divide the day into 40 units of time, as it is the established custom to divide it into 24 units that it will be much more convenient to adopt exactly 40 local times for all the local business of the world, than it now is to adopt exactly 24 local times for all local business. I have no invincible objections however to any other system of decimalizing time and longitude besides that one here used as an illustration. The thing I wish to suggest to the Committee is simply that the door be left open in their project of uniform standards for any probable reform in units of measurement.

The establishment of the 1st meridian must be independent of all nationalities, must be perfectly clear and natural by its situation on the surface of the world

133 N. Bouthillier de Beaumont

No.
Ann. Soc.
C. E.

NAME.

QUESTION 11.

134 Andrew Ingraham.....

and known by all nations. The Behring's strait dividing exactly the continents, seems to me favourable for this choice. Thus for ex. Cape of Prince of Wales 0 h (midnight), Washington 6 h, centre of Europe 12 h (mid-day) &c. The fixation of the hours thus by 15 per degree is numbered by twelve on each side of the meridian mid-day.

In lieu of answer to the 11 questions contained in your circular, please accept the following.

1. Modern life is growing more and more indifferent to the distinction of day and night; science, business, labor, pleasure disregard it more and more. The evidence for the statement abounds but its truth might be inferred from our knowledge of the means at our disposal for turning day into night and night into day.

2. The more radical the change, the less it is connected with the language and calendar of any particular nation, the more likely it is to meet with general acceptance.

3. Local time is easily provided for. The sun and the stars, the ordinary time piece, almanac, newspapers, &c., insure sufficient accuracy. Its relation to universal time can be easily settled, even by mechanical contrivances which will save the trouble of reckoning.

4. Let the passage of the sun (mean sun) across the inferior meridian of Greenwich, be the beginning of the first Hemer; and each subsequent passage be the beginning of another Hemer; let this Hemer be divided into any convenient number of parts, or for instance ten, to be again subdivided into ten and so on, and let a thousand of these Hemers make an Eter (or whatever other name may be preferred). Let the time of the beginning of the first Eter be fixed by the position of the planets, and recorded and published beyond the possibility of loss; let almanacs, calendars, timepieces or pictures that will illustrate their nature be introduced that will follow Hemer time.

5. Such a system independent of an-

No.
Am. Soc.
C.E.

NAME.

QUESTION 11.

135 Joseph Trutch.....

nual sun precession of equinoxes intercalation change of style, &c., would serve as a standard of comparison for all other calendars, and be not unwelcome to the historical and chronological student, while the day laborers who have forgotten the stars and even have to tell time by the sun, could begin and quit work by the Decrees of Hemer time, as well as by the hour of local time.

In a year from now all the railroads of this country might be run on Hemer time furnished by some observatory, and agreed upon among themselves without waiting for the establishment of an "Eter" or any general action on the subject.

The details of the development of any such plan as this must be left to competent minds by whom, indeed, it may have already been considered and rejected.

Having been requested to express my views on this question, I can only say that after careful perusal of the various papers herewith, I fail to perceive that the system of Standard Time proposed therein to be substituted for the existing practice, could be carried into effect without entailing at least as many, and as material complications as occur under the natural system of measuring recording Time which now prevails.

Theoretically the proposal system would no doubt be a scientific improvement in some respects on that now adopted, and which is established by the practice of ages, but its introduction into general use would—so far as I can judge—be productive of but little practical benefit; whilst it would occasion anomalies in time reckoning as between places closely adjacent to each other but on opposite sides of the proposed arbitrary lines of time limitation, little if at all, less considerable than those now existing.

On the whole I think the balance of advantages of the existing and proposed systems, so, even that I cannot favor the change which is suggested by these papers.

No. Am. Soc. C.E.	NAME.	QUESTION 11.
-------------------------	-------	--------------

136 Alex. T. Christie.....

1. Adopt prime meridian time for all longitudes. Retain the ordinary dial turned through an angle double of the longitude, with contrary sign. This brings the hour of local meridian transit of mean sun to the zenith of the dial and disposes the hours of the natural day symmetrically with respect to this zenith. When the dial is numbered to 24, turn it through an angle equal to the longitude.

2. To overcome a perhaps disagreeable dissymmetry of the numbers in the preceding scheme, supersede them by symbols having no numerical significance—say by the zodiacal symbols, and at the prime meridians.

3. Project the earth itself upon the dial plate, north pole to centre, south pole, equator or any convenient parallel to circumference. Define and properly designate 24 meridians at hour intervals, bring the local meridian to the zenith of the dial, and direct the hour hand to the mean sun. Use one of the meridians—say Behring's Strait—to mark the discontinuity of the day, and the zero of the minute hand, or place the minute hand with the second hand in an eccentric circle (large as possible) divided to sixty parts. The quadrants say (1) Pacific, (2) Asia, (3) Europe and Africa, (4) America might be distinguished by colors or otherwise, and by the actual forms of the land and water divisions, leaving the observer to grapple more readily with the five included meridians of a quadrant, etc.

It will be seen that 1 and 2 are the present system modified so that standard meridian time might possibly serve the purposes of local time and exclude the latter; 3 does away with the odious distinction altogether by dropping the crude and artificial, I might say barbarous device of numbers, and substituting the earth itself for the dial. The Sun is then the index, and we have returned to the simplicity of things as we find them in nature. The great clock maker or the great clock to tell what time it is, is to tell where the Sun is,

No.
Am. Soc
C. E.

NAME

QUESTION 11.

137 E. P. Hannaford.

and the answer must be the same in all quarters of the Globe. I need not trouble the Committee at present, with details; should the scheme meet with any degree of approbation. I am at their service with such details as they may call for. I may say that I have sufficient confidence in the practicability of the plan, to be willing to test the matter in any public school in the city. A roughly drawn diagram partly, perhaps sufficiently, illustrative of my views accompanies this paper. Not having seen the questions sent out by the Secretary A. S. C. E. I can only say that the plan of 24 lines of discontinuity proposed in the pamphlet on Standard Time set me to thinking immediately how to get rid of them. None but a Geodesist could tell where they run and he only after a trigonometrical survey.

In these remarks I desire to be understood as referring to one universal standard time common to all peoples throughout the world. Appendix 4, page 28.

The division of the earth's surface into twenty-four meridians, representing twenty-four hours, and to confine standard time to these meridians, although presenting at first sight a simple method, yet I think in detail it will be found complex.

In connection with this proposal I submit: it does not appear to me to be so objectionable to make the hours read to twenty-four consecutively as to substitute letters for numbers from 12 to 24.

In regard to letters as a measure of time. Such symbols are not appreciative. For instance in the ordinary duties of the day in calculating the number of hours between certain periods say B o'clock, and F o'clock a person would have to reduce B and F to numerals viz., 2 o'clock and 6 o'clock (both P.M.) of our present system, and thus obtain their value as otherwise B and F are only symbols or terms and are not appreciative.

Then in regard to numbering the hours of the day to 24 consecutively.

No. Am. Soc. C.E.	NAME.	QUESTION 11.
-------------------------	-------	--------------

This system of the two appears to me to be the least objectionable.

But to adopt either case, and to destroy the terms A.M. and P.M. could not it seems to me be done, because these terms separate the day from the night. For instance 24 o'clock or midnight to us, would be noon at our antipodes (but still 24 o'clock) and it will be seen that as we are legislating for time ("throughout the world") there would be if the hours are continued consecutively to 24, a zero at midnight and a zero at mid-day; and as it is proposed to make the local day (paragraph 15, page 29) everywhere commence at midnight, it follows that when it is midnight with us, i.e. zero or 24 o'clock it will be 24 o'clock mid-day at our antipodes or 12 hours wrong to accord with paragraph 15, because it should be midnight also with them. Hence there is a confliction that shews the divisions A.M. and P.M. with 12 hours to each to be necessary, dividing as they do the night from the day.

The mechanical alterations of the works or dials of all clocks and watches would be objectionable. The dials must be numbered from 0 to 24 in one circle, or by a double series of numbers and the innovation would not be hailed with favor, unless perhaps by clock and watchmakers.

Putting the zero meridians in Behring's straits and making Greenwich 180° partly overcomes a difficulty that would otherwise entirely nullify the charts commonly used by navigators, viz., those of Great Britain. The compliment to that country is deserved but it is only partly done; and sentiment alone stands in the way of naming Greenwich meridian (Z) zero instead of meridian M.

Cities like New York, Chicago, etc., will, I think, feel slighted when a meridian passes to the east or west of them and their own local time now standard has to be sacrificed for a meridian passing through a village or in the country districts; and this will be

No.
Am. Soc.
C.E.

NAME.

QUESTION 11.

augmented as capitals and other cities come midway between these standards. Then it will be that a conflict of clocks will take place involving three different times, viz., the standards east and west and local or true time and each clock or watch will have to bear on its face the initial letter meridi. n it represents or there will be still more confusion.

The foregoing are some of the reasons which in my judgment are against the proposed system, and it further appears to me the more the project is worked out in detail, the more difficulties will arise, and that the present method of time, dividing the day into two series of 12 hours each, A. M. and P. M., has been devised with a knowledge of our acquirements and which has stood the test of time and experience.

I beg to say with all deference to the Special Committee of the Association, I fail in my experience to trace a single accident to the system of time now in use: and if, perchance, engagements are broken by reason of the change of time, I think it must be conceded that it will be so under the proposed system, and that midway between two meridians will especially be unenviable localities to reside in, for they will be subjected to three different times as I have explained, and these having a maximum difference of one hour between them. Hence, I think, the proposition of meridians at stated intervals, and irrespective of the cities they would pass through, together with the alteration of time, making the hours consecutively to 24, and with no divisions of day and night, would be impracticable, and as applied to all peoples throughout the world would be opposed to the laws of nature.

NOTE.

It has been considered advisable to give the replies in precise conformity with the written text : consequently the numbers of the pages as they are found in the Pamphlet of the American Society Civil Engineers have been retained. This course exacted the retention of the same figures in the questions.

The equivalents in these pages are as follows :

PAMPHLET AM. SOC. CIVIL ENG.					PRESENT PAMPHLET.	
Page 28 =	..	..	..	..	Page 2, 3.	
" 29 =	..	..	..	..	" 4, 5.	
" 30 =	..	..	..	..	" 6.	
" 31 =	..	..	..	..	" 7.	
" 32 =	...	..	...	..	" 8.	
" 33 =	..	..	..	..	" 9.	
" 34 =	..	..	..	..	" 10.	

ALPHABETICAL REFERENCE.

NAME	No. List A.S.C.E.	NAME	No. List A.S.C.E.
A		H	
Adams, Julius W.	34	Haight, Stephen S.	33
Alexander, E. P.	61	Hall, James	22
Anderson, Wm. P.	84	Hamilton, John B.	109
Archibald, L. B.	53	Hannaford, E. P.	137
Archibald, P. S.	46	Harlow, James H.	36
Ashe, E. D.	75	Harrington, Mart W.	3
B		Harrod, B. M.	19
Barber, James R.	91	Hazen, Wm. B.	72
Bass, Lewis	101	Henning, B. S.	48
Beaumont, de N. Bouthillier.	133	Herschel, Clemens.	9
Becker, M. J.	2	Hill, Edwin A.	96
Blake, Clarence J.	126	Horr, Asa.	82
Blake, John H.	130	Howe, H. A.	88
Braibury, William F.	114	Howe, M. G.	26
Briggs, Robert	11	Howley, James P.	60
Brooks, Fred	132	I	
Brydone-Jack W.	108	Ingraham, Andrew	154
Buchan, J. M.	73	Ingalls, Rufus.	85
C		Ives, C. J.	81
Call, R. R.	118	J	
Christie, Alex. S.	136	Jacobs, W. E.	86
Clark, Jacob M.	111	Jennings, W. T.	25
Comstock, C. B.	13	Jerome, David H.	104
Cox, A. B.	37	Judson, W. H.	76
Crosby, Wilson	77	K	
Crowell, J. Foster	29	Kennedy, George	74
D		L	
Davidson, C. S.	55	LeConte, L. J.	68
Davis, Jos. P.	46	Lynch, Francis J.	17
Dawson, Geo. M.	66	M	
Doane, E. A.	7	Maguire, Edward	56
Doane, W. A.	16	Mallet, J. W.	119
Dui, Melville	102	Master, C. S.	21
Dunnington, F. P.	124	Maxwell, James R.	15
Duraye, Julius J.	64	May, W. A.	20
Dwight, H. P.	113	Meigs, M. C.	98
E		Mendenhall, T. C.	67
Eastman, J. R.	90	Moore, Robert.	23
Eddy, H. T.	4	Murray, Alexander	95
Ellice, Wm. F.	94	MacLeod, Henry F.	110
F		McAlpine, W. J.	1
Fernald, M. C.	129	N	
Forris, E. G.	57	Newcomb, Simon P.	92
Fletcher, Robert	5	Newberry, Fred T.	120
Fontaine, Ed	131	Norton, Wm. A.	50
G		Notman, John.	30
Gatchell, George S.	79	P	
Gannet, Henry	59	Pearl, J. W.	116
Giddings, M.	117	Perry, J. H.	41
Gillespie, J. L.	83	Philbrick, Edward S.	38
Gilpin, Edwin	122	Philbrick, P. H.	6
Gisborne, F. W.	35	Pickering, Edward C.	69
Goodwin, H. Stanley	10	Pohlman Julius.	99
Greenough, M. S.	15		

ALPHABETICAL REFERENCE

NAME	No. List A.S.C.E.	NAME	No. List A.S.C.E.
P			
Potter, T. J.	31	Taylor, D. R.	89
Pratt, W. H.	78	Thornton, Wm. M.	127
Pritchett, H. S.	80	Titlow, J. Milton	49
Putnam, J. W.	42	Towar, F. M.	63
R			
Richardson, Henry B.	8	Trutch, Joseph	135
Robinson, Menckure	39	Tully, Kivas	40
Rowan, James H.	18	Tupper, Sir Charles	44
Royle, H. F.	70	Twigg, John	123
S			
Sampson, W. T.	105	Upton, Winslow	87
Savage, Chapman Albert	128	W	
Sayre, Robert H.	27	Ward, C. D.	97
Schreiber, Collingwood	58	Werden, S. L.	115
Schott, Char. A.	103	Wilkins, Geo. C.	112
Sedgwick, Thomas S.	65	Wood, DeVo'son	93
Sewell, J. S.	71	Wood, J. C.	100
Shedaker, D. Hudson	121	Wood, W. H.	62
Shailer, Robert A.	52	Wurtele, Arthur S. C.	93
Smith, H. S. S.	107	Y	
Smith, Francis H.	125	Young, C. A.	51
Smelle, W. B.	32		
Spencer, S.	12		
Stearns, F. P.	54		
Stevens, H. E.	47		
Stone, Ormond	106		
Swan, Charles H.	43		
Sweet, W. A.	24		

No. List
 A.S.C.E.
 33
 22
 109
 137
 36
 3
 19
 72
 48
 9
 96
 82
 88
 26
 60
 154
 85
 81
 86
 25
 104
 76
 74
 68
 17
 56
 119
 21
 15
 20
 98
 67
 28
 95
 110
 1
 92
 120
 50
 30
 116
 41
 38
 6
 69
 99